EDISON ELECTRIC INSTITUTE BULLETIN

NOVEMBER, 1938

The TVA Yardstick . . . . . C. W. KELLOGG 465

Statement to the TVA Investigating Committee WENDELL L. WILLKIE 468

Comments on the TVA's Report on Allocations of Investment of Norris, Wheeler and Wilson Dams . . . . H. S. BENNION 469

Final Plans for the Second National Accounting Conference . . . 477

Individual Accounting Committee Meetings 479

Program for the Accounting Conference 480

The Rural Electrification Job of Consumers Power Company . . . 481

American Street and Highway Lighting Practice . . L. A. S. WOOD 487

Considerations Involved in Making System Investments for Improved Service Reliability . . . . . S. M. DEAN 491

Discussion of Above Paper by R. A. Hentz and H. S. Fitch 495

Ground Line Treatment of Standing Poles . . . . F. W. PACKER 499

Modern Kitchen Bureau Activities . . . . . H. L. MARTIN 503

Conventions and Meetings, 504

EDISON ELECTRIC INSTITUTE

STATISTICAL DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY

Compiled Monthly by the Edison Electric Institute—Covers 100% of the Industry

DURING THE MONTH OF AUGUST

	1938	1937	%
	SOURCE OF ENERGY		
Kilowatthours Generated (Net)			
By Fuel Burning Plants	6,145,826,000	7,117,303,000	−13.6
By Water Power	3,507,427,000	3,046,375,000	+15.1
Total Generation	9,653,253,000	10,163,678,000	− 5.0
Net Purchases			
From Other Sources	320,978,000	280,243,000	+14.5
Net International Imports	97,980,000	109,607,000	−10.6
Total Purchased Power (Net)	418,958,000	389,850,000	+ 7.5
Total Input	**10,072,211,000**	**10,553,528,000**	− 4.6
	DISPOSAL OF ENERGY		
Total Sales	**8,092,624,000**	**8,616,795,000**	(a)
Energy Not Reported as Sold			
Used in Electric Railway Department	28,552,000	46,538,000	(a)
Used in Electric and Other Departments	147,711,000	140,151,000	(a)
Furnished Free or Exchanged in Kind	1,459,000	(Not Shown)	(a)
Total Not Reported as Sold	177,722,000	186,689,000	(a)
Total Energy Accounted For	**8,270,346,000**	**8,803,484,000**	− 6.1
Losses and Energy Unaccounted For	1,801,865,000	1,750,044,000	+ 3.0
Total Output (To Check Above **"Input"**)	**10,072,211,000**	**10,553,528,000**	− 4.6

CLASSIFICATION OF KILOWATTHOUR SALES

Based on FPC Classification—August, 1938		**Based on EEI Classification—August, 1937**	
Residential or Domestic	1,526,834,000	Domestic	1,384,028,000
Rural	(Allocated to Other Classes)	Commercial—Small Light and Power	1,483,585,000
Commercial and Industrial	5,773,021,000	Commercial—Large Light and Power	5,060,921,000
Public Street and Highway Lighting	144,308,000	Municipal Street Lighting	172,862,000
Other Public Authorities	199,361,000	Street and Interurban Railways	330,912,000
Sales to Railroad and Railways	412,963,000	Electric Steam Railroads	96,427,000
Interdepartmental	31,621,000	Municipal and Miscellaneous	88,060,000
Other Sales	4,516,000		
Total Sales	8,092,624,000	Sales to Ultimate Customers	8,616,795,000

CLASSIFICATION OF CUSTOMERS

Based on FPC Classification—August 31, 1938		**Based on EEI Classification—August 31, 1937**	
Residential or Domestic	22,835,489	Domestic	22,123,271
Rural	(Allocated to Other Classes)	Commercial—Small Light and Power	3,848,704
Commercial and Industrial	4,567,824	Commercial—Large Light and Power	565,391
Public Street and Highway Lighting	26,188	Municipal Street Lighting	33,838
Other Public Authorities	72,463	Street and Interurban Railways	322
Railroad and Railways	280	Electric Steam Railroads	26
Interdepartmental	134	Municipal and Miscellaneous	35,373
Others	3,701		
Total Customers	27,506,079	Total Ultimate Customers	26,606,925

REVENUE (b)

Based on FPC Classification—August, 1938		**Based on EEI Classification—August, 1937**	
Revenue from Sales (Excluding Sales to Other Elec. Utilities)	$180,293,300	Revenue from Ultimate Customers	$181,448,400
Other Revenue	2,087,000		
Total Revenue	$182,380,300		

ESTIMATED DOMESTIC ELECTRIC SERVICE RATIOS

(For the 12 Months Ended August 31st)

	1938	1937	%
Kilowatthours per Customer	837	778	+ 7.6
Average Annual Bill	$35.84	$34.87	+ 2.8
Revenue per Kwhr	4.28¢	4.48¢	− 4.5

(a) Data for two years not strictly comparable.
(b) Data not comparable because of an unascertainable amount of "Revenue" in August, 1938, which may or may not have been included in the 1937 data.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 6 NOVEMBER, 1938 No. 11

The TVA "Yardstick"

Outline of Testimony Presented before the Joint Congressional Committee to Investigate the Tennessee Valley Authority, November 22, 1938

By C. W. Kellogg

President, Edison Electric Institute

Note: Hearings of the Joint Committee appointed by Congress last Spring to Investigate the Tennessee Valley Authority were resumed at Washington, November 15. Private utility witnesses appearing before the Committee, include Messrs. Wendell L. Willkie and Bernard F. Weadock in addition to Mr. Kellogg. Mr. Willkie's formal statement to the Committee appears in this issue. Mr. Weadock's testimony will appear in a later issue.

SUMMARY OF THE TESTIMONY

1. A private company desiring to develop electric power on a navigable stream must, under the Federal Water Power Act, at its own expense, pay for the full cost of navigation improvement except only the lock itself, or in any event gets no refund from the Government nor from anybody else for the value of the general improvement it makes to navigation. (TVA disregards for power purposes a large part of its actual investment in dams by allocating a large part to navigation.)

2. A private company must pay interest and taxes during construction and (where some time is required to load up the plant) preliminary losses in operation. (TVA pays none of these, although their entire investment is represented by interest-bearing debt of the nation and all taxes not paid by them must be added to the tax burden of others.)

3. A private company must pay interest charges on all of its investment cost as above stated, and provide for depreciation of its investment over a term of years. (TVA pays, or so far in its published earnings statements has charged itself with, none of these.)

4. With four of the most important such private investments in navigable streams, charges (interest, depreciation and taxes on investment) comprise 92% of the cost of producing hydro power. (TVA charges itself nothing for the first two of these and a merely nominal amount for taxes.) Is this a fair or factual yardstick?

THE TESTIMONY is on the so-called "yardstick" (for measuring the electric rates of privately-owned utilities) supposedly furnished by the operations of the TVA. The testimony is purely factual.

Since the TVA "yardstick" is supposed to measure the rates charged by private utilities, it is necessary first to understand the basic conditions surrounding the electric utility business.

The most fundamental of these basic conditions is the relatively large amount of capital required by the utilities compared to other businesses. Fixed capital with the utilities amounts to about $6 per dollar of annual gross earnings. Based on the last Census figures available, the corresponding figure for industry as a whole is 71c. So the utilities require proportionately over eight times as much capital as industry. In the case of hydroelectric development, this ratio of plant to annual gross earnings is 10 or more, so that hydro development needs over 13 times as much capital for its earnings size as industry.

From this fundamental fact it follows that the fixed charges on investment (interest or dividends, depreciation, taxes, etc.) comprise five-eighths of the total cost of furnishing electricity in the case of the average utility, and over 90% of the cost in the case of a hydroelectric plant selling wholesale.

It is clear, therefore, that accuracy in accounting for investment, and for the fixed charges arising therefrom, is the first essential of any rate yardstick that can claim any pretense of being factual or fair. What are the facts as to TVA in this fundamental essential?

1. TOTAL INVESTMENT

Privately-owned utilities have to raise *all* their capital requirements. These include not only the labor and material going into the physical property, but the cost of interest and taxes during the construction period, general overhead expenses and in some cases (notably large hydro plants) inadequate earnings during the initial development period. The TVA, by failing to allow for some of these items which private companies have to provide for, shows the following:

Total Value Before Any Allocation as Between Objectives

	Reported by TVA (in the allocation reports)	Cost Plus Overheads Mentioned
Wilson Dam	$30,120,009	$77,581,000
Wheeler Dam	32,473,542	39,384,000
Norris Dam	31,532,120	44,075,000
Step-up Substations	3,564,763	*
	$97,690,434	$161,040,000

*Included in other figures.

TVA starts, therefore, with an alleged total value 60% as great as privately-owned utilities would have to pay for from their own resources. TVA may argue that they paid no interest or depreciation or overhead, nor had to bother about deficient earnings during the development period (all of these being carried by the taxpayer), but any rates resulting could not be a fair measure of

what someone else, who did have to pay all such costs, would be up against.

Allocation of Costs—Starting with the foregoing base, 60% of actuality, TVA then proceeds to allocate investment cost as between (1) flood control, (2) navigation, (3) fertilizer, (4) national defense and (5) electric power. It finds that 40% of joint investment should be allocated to power, giving the following values:

Allocation of Costs (Wilson, Wheeler and Norris Dams) Published June 17, 1938

	Direct Charges	Joint Investment	Total
Flood Control	$ 2,600,000	$15,870,627 (25%)	$18,470,627 (20%)
Navigation	4,075,988	22,218,877 (35%)	26,294,865 (28%)
Fertilizer*	.....	.....	.....
National Defense	.....	.....	.....
Power	23,967,177	25,393,002 (40%)	49,360,179 (52%)
	$30,643,165	$63,482,506 (100%)	$94,125,671 (100%)

*Charged with power used, which is equivalent to allocating part of the capital costs.

The gross cost to the people of $161,000,000 is thus whittled down to $49,000,000—30% of the larger figure. This percentage may be compared with the case of the Bonneville Dam on the Columbia River, where only 22% of the initial investment and 57% of the eventual investment has been allocated to power, all the rest going to navigation. The point stressed is that costs based on such allocations are not a factual or fair measure of what private companies (who must perforce allocate 100% to power) can do.

2. ACTUAL CURRENT CHARGES

Aside from the matter of allocation just referred to, the actual costs of privately-owned hydroelectric properties on navigable streams show that over 90% of their total costs consist of (1) return on investment (interest on bonds or dividends on stock), (2) depreciation, and (3) taxes. Yet to date the TVA, in its statements of operation, has charged nothing whatever for either interest or depreciation and for taxes only a nominal sum of about 1/10%. In a word, the items mentioned, which represent 90% of the cost of hydroelectric power to private companies, the TVA in its published earnings statements has almost completely ignored. How can such a procedure represent a fair or factual yardstick?

The TVA argues that it charges no interest because it pays none; but the *entire* cost of the TVA development is represented in the debt of the Federal Government, so the taxpayers carry it. Whatever the reasons for not making these charges, the results so obtained cannot be an accurate measure of the costs of those who do have to pay such charges.

Fiscal Year	*Kilowatthours Sold*	*Amount Received*	*Average per Kwhr*
1935	100,681,000	$ 563,000	5.60 mills
1936	437,451,000	1,162,000	2.66 mills
1937	731,587,000	1,630,000	2.22 mills
1938	699,303,000	2,265,000	3.23 mills

Competitive Effect

The electric utility industry as such is not now raising the question of the wisdom of using general taxes to subsidize special localities. The reason it objects strenuously to the TVA accounting is this: The TVA, has set itself up as a yardstick of what private companies should charge for electricity, and has used and is using the advantage in costs arising from huge subsidies from the taxpayer to compete with private investors who enjoy no such subsidy.

The committee should consider the following figures obtained largely from the TVA published reports, the Federal Budget or testimony before Congressional Committees.

The average price received by TVA for electricity sold has been as follows:

An analysis of the outstanding power contracts which have been made by TVA would indicate that future years will not show gross earnings in excess of from 3½ to 3¾ mills per kilowatthour.

These figures might be compared with the TVA estimate before the Appropriations Committee in 1936 of 4 mills per kilowatthour at the generating plant.

Even with the relatively small amounts allocated by the TVA to power investment, this power in 1937 cost 6.32 mills per kilowatthour. This is computed as follows:

The allocated investment plus transmission lines was		$67,476,000
Charges on this are (minimum):		
Interest	3½%	
Depreciation	2 %	
Total	5½% on $67,476,000	$ 3,711,206
Taxes actually paid (0.11%)		71,051
Operating Expenses (net) as reported by TVA (p. 1018)		852,291
		$ 4,634,548

or for 731,587,000 kwhr. . 6.33 mills per kwhr

TABLE I—Comparative Cost of Steam and Hydroelectric Power

Assumptions

1. Present cost of 100,000 kw steam plant, including step-up station, $10,000,000 ($100 per kw including reserve capacity), 850 lbs. pressure, 900 degrees temperature.
2. Price of coal $3.00 per ton. (14,000 Btu per lb.)
3. Fuel economy obtainable at 60% load factor, 12,000 Btu per kwhr.
4. *Fixed Charges:*

	Steam	*Hydro*
Interest	6%	6%
Depreciation	3%	2%
Taxes	2.65%	1.6%
	11.65%	9.6%

5. Cost of hydro plant $201 per kw of continuous capacity, including step-up station.

Cost in dollars per kilowatt	*Steam*	*Hydro*
Fixed charges	$11.65	$19.30
Fuel $\frac{300}{2000} \times \frac{12}{14} \times 5256$	6.75	....
Operation and Maintenance (½ mill)*	2.63	1.73(a)
Total	$21.03	$21.03
Per kwhr	4.18 mills	4.18 mills

*Kansas City actual 0.42 mills.
(a) Calculated from TVA data.
Showing that at 60% load factor and other conditions above stated, steam is cheaper than hydro for any plant cost per kilowatt for hydro above $201.

Note Re Secondary Power

If available 75% of the time, such power must bring 1.8 mills per kwhr. in order to pay to develop. The income from such power at such rate would pay charges and costs on only $65 per kilowatt, which is the cost of installing such machinery. Secondary power available less than 75% of the time or with less than 1.8 mills per kwhr. would not pay to develop.

Cost per Kilowatt of TVA System

In testifying in a lawsuit in 1937, TVA representatives submitted data showing that the net continuous power capacity of the completed system of TVA dams, after allowing for flood control storage, would be 564,000 kilowatts. At a 60% annual load factor this would be 940,000 kilowatts.

For the total system cost, estimated at $520,000,000, this would amount to $553 per kw of continuous capacity at 60% load factor. With 9.6% for charges (6% interest, 2% depreciation and 1.6% taxes) which a private company would have to pay, such charges would amount to $53.09 per annum, or 10.1 mills per kwhr at a 60% load factor.

Adding to this the operating cost of 0.4 mill, would make a total cost of 10.5 mills per kwhr, which is over 160% more than TVA, in reporting to Congress, estimated it would earn and over three times as much as the TVA did actually earn gross per kwhr in the fiscal year 1938.

These figures are the true yardstick measure of what private companies would have to pay to produce this power and explain why such large allocations of expenditures were made to other things than power. But they emphasize how far TVA, as allocated, departs from an accurate power yardstick.

The Steam Yardstick

One definite yardstick comparison which the taxpayer should make in order to determine whether his money has been wisely used in the development of hydroelectric power on the Tennessee River, is that with the cost of production by coal. Few people realize how drastically this situation has changed in the last generation.

When the Keokuk Dam on the Mississippi River was being projected in 1907, the average coal consumed to produce a kilowatthour of electricity country-wide was 5.4 pounds. Ten years later it was 3.3 pounds and today a modern steam power station of 100,000 kw capacity, using West Virginia coal, and operating at 60% annual load factor, can produce a kilowatthour from 0.86 pounds of coal—less than one-sixth of the amount required on the average a generation ago.

With this condition known and with wide experience with operation of steam plants to rely on, it can be shown that today no hydro plant in the Tennessee Valley is economically justified if it costs more than $201 per kilowatt of continuous capacity, compared with the $553 per kilowatt the system will actually cost. The figures supporting this are shown as Table I. The assumptions represent well established present practice. The cost of steam generating equipment per kilowatt has declined in the past decade, while hydro generating equipment has advanced 15 to 20% in that period.

The total cost of TVA dams (using their own figures for cost of continuous capacity—$922 per kilowatt, or $553 per kilowatt at 60% load factor) is thus over 2½ times the amount of equivalent steam costs.

Table II

Comparison of TVA Customer (Tupelo, Miss.) and a Private Company of Similar Size (Mesilla Valley Electric Co. of Las Cruces, N. M.) Both Purchase Their Supply of Power for Distribution and Sale

I. Comparative Statistics as of May 30, 1938

	Tupelo	*Las Cruces*
Annual Energy Sales (kwhr)	9,295,100	10,033,371
Highest Peak (12 mos. ending) (kw)	2,304	2,496
Annual Load Factor	46.1%	46.0%
Number Residence Customers	1,526	2,216
Kilowatt hours per Residence Customer per Year	2,012	2,094
Per Cent Saturation:		
Refrigerators	88%	64.9%
Electric Ranges	24%	51.1%
Electric Water Heaters	8%	31.8%

II. Financial Figures as of June 30, 1937

	Tupelo	*Las Cruces*
Plant and Equipment	$220,573	$922,942
Same per Kilowatt Peak Load	95	371*
Electric Utility Industry in the United States as a Whole		
Investment per kw of Peak (10% spare)	$396	
Exclusive of generating capacity (77.5%)	307*	

*Las Cruces has no power station but serves a relatively sparsely settled community.

III. Earnings and Expenses (12 Mos. Ending June 30, 1937)

	Tupelo	*Cents Kwhr*	*Las Cruces*	*Cents Kwhr*
Gross Earnings	$132,892	1.32	$247,438	2.43
Less Bad Debts	153		1,469	
Gross Collected (A)	$132,739		$245,969	
Operating Expenses				
Power Purchased (B)	$ 52,514	.53	$ 77,742	.76
Other Operating Expenses:				
Distribution & Utilization	10,290	.10	19,429	.19
Commercial & New Business	3,247	.03	21,866	.21
General	5,484	.05	21,331	.21
Total Other (C)	19,021	.18	62,626	.61
Total Operating Expenses (B + C)	$ 71,535	.71	$140,368	1.38
Charges				
Taxes	$ 12,028	.12	$ 20,947	.20
Depreciation	8,025	.08	24,623	.24
Total Charges (D)	$ 20,053	.20	$ 45,570	.44
Gross Income A − (B + C + D)	$ 41,151		$ 60,031	
Non-Operating Income	2,493		5,536	
Net Income for Return	$ 43,644	.43	$ 65,567	.64

Ratios Las Cruces to Tupelo

Purchased Power	1.48
Other Operating Expenses	3.31
Charges	2.28

TVA Yardstick Not Necessary

All of the hundreds of hydroelectric developments throughout the country, licensed since 1920 under the Federal Water Power Act by the Federal Power Commission, are under the most rigid

(*Continued on page* 490)

Statement to the TVA Investigating Committee

By Wendell L. Willkie

President, The Commonwealth & Southern Corporation

Text of the formal statement by Wendell L. Willkie, President of The Commonwealth & Southern Corporation, presented November 23rd, before the Joint Congressional Committee to Investigate the Tennessee Valley Authority

IN appearing before your Committee, I want first of all to express my conviction that you have the power to make a very important contribution to the national welfare. The consequences of the situation which we are here considering are not confined merely to the TVA or the utility industry. They directly affect a problem in which we are all most deeply concerned —the nation's economic recovery. Business is now showing signs of improvement—just as it did a year and a half ago. This improvement will be short lived—just as it was a year and a half ago—if the manufacturers of heavy goods are unable to join in this expansion. Economists generally recognize that one of the greatest factors in economic recovery is the utility industry—an industry which is a principal market for construction materials and heavy machinery and which, more than any other, can stimulate the flow of capital and the reemployment of men.

In this brief statement I want to suggest a method whereby your Committee can break the log jam in the utility industry and can contribute materially to national recovery.

In the past five years electric utility expenditure for new construction and new equipment has been far less than necessary because the utilities have been unable to obtain the required capital. It is my estimate that in 1938 these utilities will spend approximately four hundred million dollars on capital construction. For the next two years the industry, including the company which I head, has pledged the government its wholehearted cooperation in the national defense program. In my judgment, however, even with this special stimulant and this special effort and even with the pick-up in general business, the utilities will not be able to spend, under present conditions, over five hundred million dollars in 1939, and, insofar as can be predicted, not more than that in 1940.

As contrasted with this probable expenditure, Mr. Frank McNinch, former head of the Federal Power Commission, has estimated that the utilities need to spend about one and one-half billion dollars each year for the next five years. And all students of the power industry, whether they work for the government or the private utilities and whether or not they adopt Mr. McNinch's particular figure, will agree that the utilities must spend far more than they are currently able to spend if they are to meet adequately the nation's growing power requirements.

Now, it is a natural question to ask: If the utilities need to spend so much money a year, why don't they spend it? The answer is that they are unable to get the necessary capital from the investor. In my opinion, they need to raise two billion dollars in common stock money for the purposes of expansion, balancing of capital structures and reorganization and simplification required under the Public Utility Holding Company Act. But the investor is afraid of what the government intends to do with the utilities. He will remain afraid *as long as the basic problem of subsidized federal competition is unsolved.*

The investor has before him a very clear and simple picture of what the government is doing to the utilities in the Tennessee Valley. The TVA spends several hundred million dollars to build its power dams and generating plants. Then the PWA, another governmental agency, provides the municipalities with the money necessary to build distribution systems so as to buy that power. Thus the municipalities get their power from the TVA. They get a free gift from the government of 45 per cent of the money to construct their own distribution systems. The government loans the rest at low interest rates. No one can blame them for yielding to so tempting an offer, financed by the taxpayers throughout the nation.

In this way the TVA not only produces power but through its cooperation with the PWA it captures the markets of the utility companies and sells the power to the consumer. Utility properties without a market are valueless except as junk. Your counsel, Mr. Biddle, seems to recognize the importance of this PWA alliance since, in acting for your Committee investigating the TVA, he asks us for an account of our activities in opposing PWA grants.

The effect of the TVA-PWA combination upon the investor can be easily imagined. He knows that no private utility can meet this subsidized competition. The most it can hope for is to sell its property at a fair price. But he knows also that the TVA and the municipalities acting in concert are forcing the utility companies to sell at the prices which they dictate. In effect the government holds a gun to the head of the utility and says "Sell at our prices or we will duplicate!" The investor knows that if that happens in one part of the country it may happen in any part. That is why in the five years 1933-1937 inclusive, the utilities have been unable to raise any common capital.

It is this legitimate and justifiable fear on the part of the investor which has made it impossible for the utility industry to get the money for its expansion. You cannot *talk* a fear of this kind away. Neither your declarations nor mine nor anybody else's will bring this capital into the industry as long as the TVA-PWA combination threatens to destroy the private utility companies.

It is obvious that I have a selfish interest in eliminating this Government competition because it would remove the policeman's "STOP" sign from our business and permit us to expand our operations and prepare to meet the demands of the future. It would also relieve us of the expense of resorting to the courts in an effort to protect the investment of our security holders—an expense which has amounted to several hundred thousand dollars in the past five years.

But the public has an even greater interest in settling this controversy. It is my conviction that the resumption of normal expenditures by the utility industry would be one of the decisive fac-

(*Continued on page* 498)

Comments on the TVA's Report on Allocation of Investment of Norris, Wheeler and Wilson Dams

By H. S. Bennion
Assistant Managing Director, E.E.I.

The TVA Report was Submitted to the President in June, 1938

Summary of These Comments

The TVA allocation report for Norris, Wheeler and Wilson Dams has charged power with only 20 per cent of its full cost at the three dams.

The report starts out with only 60 per cent of the total cost to date to the Federal Treasury of the three dams, including overhead expense, interest during construction and interest less earnings since the power plant went into operation.

It charges off 48 per cent of the remaining 60 per cent to navigation and flood control, though only the net cost of the locks at Wheeler and Wilson Dams, amounting to about 4 per cent, can reasonably be charged off at this time. This leaves to be charged to power only 33 per cent of the full cost of the three dams.

If these dams had been built by private enterprise, under the provisions of the Federal Water Power Act, power would have been required to bear over 95 per cent of the total cost, according to the experience of licensees under that Act.

If the TVA operations are to be used as a yardstick of the fairness of prices of sound business enterprises, the cost of dams should not be credited with navigation benefits until, and only to the extent that, real benefits or revenues shall have arisen from bona fide commerce. The history of commerce for the past fifty years on the improved rivers of the Mississippi Valley affords little promise of such benefits. It would take a great deal of traffic and substantial toll charges on lockages just to pay the fixed and operating costs on the locks alone.

Pending ample demonstration, after the generating plants have become loaded to capacity and direct conflict has developed between the use of reservoir storage capacity for providing firm power capacity and for flood storage, no part of the cost of the dams should be allocated for flood control benefits. Should it be demonstrated in practice that this flood storage capacity will be preserved, the cost of the dams should then be credited with the actual reduction in the cost of the alternative flood control measures: a two or three million dollar reduction in the cost of flood dikes at Chattanooga and any measurable reduction in the cost of flood control works of the adopted Mississippi River project. Such credit could be but a relatively small part of the total cost of the entire eleven TVA dams.

Interest during construction was not included in determining the cost of Norris and Wheeler Dams. In previously fixing the value of Wilson Dam, interest during construction was not included. Annual charges about one-third of those determined by business experience and in general use today by the engineering profession have been used by TVA engineers to show that the power from seven dams now built or under construction will be compensatory. This was apparently basis for the statement by the Chairman of the TVA in the letter of transmittal that power revenues derived from the normal capacity of the three completed projects will be sufficient to cover all of the costs of operation, including depreciation and 3 per cent interest on the investment allocated to power, and in addition to return in thirty years the entire investment allocated to navigation and flood control.

The combined effect of this accounting is to relieve power revenues from supporting about 90 per cent of the annual fixed charges reasonably assignable to power development. Since fixed charges are 90 per cent and annual operating expenses (labor, supplies, etc.) are only 10 per cent of the total annual cost of power from hydroelectric generating stations, it follows that the total annual cost of power generation at the three dams has been written down 80 per cent.

The TVA allocation report properly omits transmission, substation and steam standby costs from the allocation, but if its power marketing program is carried out, these costs must become very large, and will render still less compensatory its established power rates.

The Act required that Wilson Dam, built before the TVA, be valued. In the TVA allocation report it is assigned $30,120,009, as compared with $32,473,542 for Wheeler Dam. Yet Wilson Dam has twice the volume of concrete at Wheeler Dam, required two and a half times the amount of excavation work, has nearly twice the height and has a present installed capacity nearly three times greater than Wheeler Dam and an ultimate capacity one and three-quarter times as great.

The construction cost of Wilson Dam, from 1926 to 1933, has been depreciated at a rate of 5.93 per cent per annum on a sinking fund basis with interest at 4½ per cent. Had it been applied since 1933 it would have depreciated the entire cost in twelve and a half years, or by the end of 1939. The TVA Annual Reports heretofore have shown no charges whatever to depreciation on Wilson Dam since taking over its operation in 1933.

Norris, Wheeler and Wilson Dams are by far the most economic of the eleven dams built or planned by the TVA. These dams have 60 per cent of the initial installation of power capacity and cost only 25 per cent of the total initial cost. Therefore the entire eleven dam projects will make a much less favorable showing when its cost is allocated.

THE Tennessee Valley Authority, created May 18, 1933, announced its power rates on September 14, of the same year. Almost five years later, to carry out a provision of the Act, it presented a recommended cost allocation, such an allocation being a prerequisite for determining compensatory charges for power.

Since the rates for power from the TVA dams have long since been established, the present cost allocations can only be a justification or defense for rates which had been determined by other considerations.

The cost allocation of the TVA dams is of vital interest to electric utilities because one of the stated major purposes of the TVA Act is to establish, through the operations of this Federal power project, a yardstick for measuring the fairness of the rates of electric utilities. Accounting for its cost therefore becomes a matter of importance. Unfortunately, considering the fact it is the Federal Government that is setting the standard of fairness and that this standard is to determine the soundness of investment in a twelve and a half billion dollar industry, the annual and special reports of the TVA to Congress, instead of being painstaking models of completeness and clarity in accounting, are hopelessly lacking in consequential accounting information. Only by a careful study of the statements presented by TVA spokesmen to appropriation committees of Congress when asking for more money and of statements submitted by its representatives to the courts can one obtain any understanding of the operations of this organization.

As a power generating system the TVA project is very uneconomic. The dams are expensive to build, drown out enormous areas of the most fertile land in the state, and the river run-off fluctuates widely during a period of years so that the capacity of the dams for supplying continuous power is comparatively small. Steam power could be supplied more cheaply. Finding this to be the situation, the TVA naturally has sought ex-

cuse for sloughing off a large part of the actual cost incurred in carrying out the undertaking.

Premises Determine the Answer

In attempting to solve an engineering problem, the answer one gets is determined by the basic assumptions made, or the premises from which the solution is started. The rest of the proceeding is largely arithmetic, which can but lead to the results that were fixed when the premises were taken. Brushing aside the scholarly discussion of the TVA Committee on Financial Policy, it will be found that in three important respects the allocation of investment in Norris, Wheeler and Wilson Dams is unsound in its basic assumptions. It waves aside a very substantial part of the actual expenditures entailed by reason of the construction of the dams; it assigns indefensibly higher values to navigation and flood control benefits than present circumstances justify; and it has assumed fixed charges on capital investment that are far below those ascertained by experience in that field of business.

Actual Cost Written Down

So far as the national debt, which catches every dollar spent by the Federal Treasury, is concerned, not only the outright expenditures for building a government dam but the overhead costs of the government chargeable to the undertaking, interest during construction, and also the difference between compound interest and earnings, during the period before income catches up with expenses, are all a part of the total cost.

It has never been the practice in government accounting for specific operations to take account of the increase in the general expenses of the government arising from such operation. Yet it is evident from the expansion in the number of government employees, in the number of buildings and amount of floor space occupied, and in the amount of supplies consumed, that the increase in cost is substantially more than the direct expense of the increased operations engaged in. In other words, as in the case of private business, there is a substantial overhead expense attached to each operation engaged in. The building of Norris, Wheeler and Wilson Dams and their subsequent operation have added considerably to the administrative cost of other departments of government. The Treasury Department, the Department of Justice, the Post Office Department and various other Federal agencies have had their costs increased substantially by reason of the building of these dams. Although not clear from its reports, it is doubtful, judging by other allocations, that the TVA has allocated a full share of its own large overhead expense to the cost of building Norris and Wheeler Dams.

When the government invades the field of business and sets up its prices as a yardstick for measuring the prices of private enterprise, this substantial element of cost should be accounted for.

The average business man knows that overhead costs in his business run about 10 per cent. This overhead or general expense constitutes about 20 per cent of operating costs of electric utilities. In a huge government organization bound by red tape, overhead expense is surely no less than it is in private enterprise.

During the market development or loading up period of a business, it is to be expected that income will not equal expenses. If a business is to be truly self-supporting, such loss must be added to capital cost and the rates adjusted accordingly, as Great Britain is doing in the case of the British Grid,[1] or the rates must be set high enough initially to compensate for the fact that the new enterprise will operate only partly loaded for the first ten to fifteen years.

Since the TVA has not set its initial rates so as to compensate for the loading up period, but has set them on the basis of plants operating from the start at full capacity, the difference between interest charges and earnings, until earnings exceed interest, should be added to capital cost, as the British Grid is doing.

This is a very important cost factor which cannot fairly be ignored in any yardstick accounting. Because of the enormous capital expenditures the TVA has already made, fixed charges on the completed projects and interest on the projects under construction amount to several times even the estimated revenue less operating expenses, and the actual revenue has been far below estimates. In 1937 the TVA estimated that in 1938 it would have a gross revenue from the sale of electric energy of $3,700,000,[2] whereas its actual revenue that year from the sale of electricity was $2,312,735,[3] or only 62.5 per cent of the estimate. Its estimate of operating expenses have been wrong also. In April, 1937, it estimated that its operating expenses for the fiscal year 1938 would be $941,000[2] and in July, 1938, reported operating expenses of $1,096,407.[4]

Wilson Dam and power plant, which except for a small beginning was constructed after the War, involved an outright expenditure of approximately $47,000,000,[5] exclusive of interest during construction. Adding 10 per cent of overhead expense, this cost was $51,700,000. Taking the average interest rate year by year on all outstanding bonds of the Federal Government during the period of construction, which may be taken approximately as ending June 30, 1926,[6] although some construction continued for a year or two longer, the total construction cost of Wilson Dam was about $59,776,000.[7] From the time the plant went into operation to the present, interest less earnings has increased this cost to the Federal Treasury by about $17,804,000, making the present total cost of the dam about $77,580,000.[7] All this has been chopped down in TVA accounting to $31,300,000, including the step-up transformer station at the dam.[8] (These transformer stations are included with the dams in these comments, because data is not available to separate out their full original construction cost, as distinguished from the value the TVA has placed upon them.)

Norris Dam was finished in 1936 at a reported cost of $37,257,000.[9] Adding 10 per cent for overhead, this becomes $40,982,700. Interest during construction at the average rate paid by the Federal Government during the construction period at Norris Dam from October 3, 1933, to August 1, 1936, raises the total construction cost of Norris Dam to $41,991,000,[10] and interest less earnings from August 1, 1936, to the present increases the total cost to $44,075,000.[10] The allocation report carries this dam at a cost trimmed to $33,158,118, including the step-up transformer station at the dam.

Wheeler Dam is reported to have cost $33,483,559.[11] Adding 10 per cent for overhead gives a cost of $36,831,915. Adding interest during the construction period from November 21, 1933, to December 1, 1936, gives a total construction cost of about $37,624,000.[12] Since Wheeler Dam went into operation, interest less earnings to date has increased the total cost of the dam to approximately $39,384,000.[12]

The construction cost of the three dams was $139,000,000. The total cost of the three dams including overhead expense, interest during construction and interest less earnings to date was $161,000,000. This is the actual cost to the

Federal Treasury instead of the modest $94,125,671 with which the TVA has started out in making its allocation to navigation, flood control and power; though $3,564,763 in step-up transformer station costs, charged by the TVA Committee to transmission, must be added for fair comparison.

The written down cost of the three dams is just 60 per cent of their total cost to date.

Allocation of Cost

The TVA Act provides for the allocation of cost of dams and other improvements under the control of the Authority as between (1) flood control, (2) navigation, (3) fertilizer, (4) national defense and (5) development of power. In carrying out this requirement the TVA could have adopted the assumption that the dams were built for power generation and that other collateral uses of the dams should be charged with cost when and to the extent only that bona fide benefits or tangible revenues had become demonstrated realities; or it could have proceeded on the basis of charging all that it could find excuse for to the purposes other than power production, and to charge to power only what was left over. This latter course has been followed.

That the production of power was the true purpose and is the real business of Norris, Wheeler and Wilson Dams has been frankly stated on some occasions by those responsible for enacting and carrying out the TVA legislation. Mr. David E. Lilienthal, in an address at Knoxville, in 1935, said:[13]

"* * * but there seems to be some inclination to forget that these dams are not being built for scenic effect. These millions of dollars are not being spent merely to increase business activity in this area. These dams are power dams. They are being built because they will produce electric power."

In a radio address on July 31, 1934, Mr. John D. Blandford, Coordinator (now General Manager) of the TVA, said in part:

"A dam is not an isolated structure or operating unit but part of a unified development of a water system with power produced at half the cost of unorganized development and certain valuable by-products in flood control and navigation."

Mr. Lilienthal, speaking in Atlanta on November 10, 1933, said:

"If we admit that the use of electricity cannot be increased many fold; if that is our mental attitude, then we must be logical and immediately stop construction of the Cove Creek Dam and of the Joe Wheeler Dam."

On June 13, 1934, Dr. Arthur E. Morgan, appearing before the Senate Subcommittee of the Committee on Appropriations, when asked if the entire purpose of the dams were not the production of electrical energy, answered:[14]

"That is the major purpose."

Sponsors of the TVA legislation have repeatedly told Congress that the projects, including Wilson Dam, would be self-supporting. In appearing before appropriation committees, TVA spokesmen in order to obtain appropriations for additional dams have emphasized the fact that the projects would be self-supporting; that power revenues would bear the entire cost of the project. In 1936, Mr. Lilienthal, before the Appropriations Committee of the House, said:[15]

"You will note that we expect power revenues to liquidate the entire investment in fifty years and to be on a self-supporting basis soon after the construction period is over."

In 1934, Dr. Arthur E. Morgan, in testifying before the House Appropriations Committee, testified as follows:[16]

Chairman: "What are the proper receipts from all sources, including the fertilizer source too?"

Dr. Morgan: "It is my personal opinion that after a preliminary period of getting on our feet as a new undertaking this program should be amortized in twenty-five years."

Chairman: "You mean in twenty-five years you ought to get revenues sufficient to pay the operating expenses and return to the Government an investment of $310,000,000?"

Dr. Morgan: "Yes sir, it is my personal opinion that after a preliminary period of getting under way as a project. The Board of Directors has not determined upon a definite period for amortization period."

Chairman: "You think you ought to do that in twenty-five years."

Dr. Morgan: "Yes, sir."

In view of the fact that the TVA legislation was enacted with the assurance that the project would be self-supporting and pay back in a period of years the entire cost, and in view of Mr. Lilienthal's testimony[17] before a committee of Congress that the electric part of the program is virtually the only means whereby revenues are derived for the support of the program, the obligation is clear for power revenues to bear the cost of the dams. The promises have been such that Congress and the nation could reasonably expect their full performance without evasion or short-changing.

From a yardstick point of view, consider what would be required of private enterprise if it had built the dams. The Federal Government, in the Water Power Act of 1920, laid down a policy that set forth what it expected of private enterprise when building power dams that could serve multiple purposes.[18] If private enterprise had built these three dams, over 95 per cent of their cost would have had to be borne by power, according to the experience of licensees under the Act. The Federal Government, at the expense of the taxpayer, might have paid for the net cost of the locks in Wheeler and Wilson Dams, but this would have been the only expense it would have assumed. Even in that case it probably would have deferred installation of the locks until substantial use therefor had been demonstrated. In any case, the government would have required the private company to furnish power for the operation of the locks and would have required that in the building of the dam expenditures be made to reduce to a minimum the actual expense to the Federal Treasury of installing the locks themselves. In the case of Keokuk Dam in the Mississippi and in the case of Hale's Bar Dam in the Tennessee, the government required the power companies to pay for installing the locks as well, although the government supplied at its own expense the standard fittings and equipment for locks. Such was the government yardstick for private enterprise.

National Defense

The TVA report has made no allocation of cost to national defense on the ground that the project is not in operation for that purpose and that allocation should be withheld until war time use may have developed. This is sound reasoning and should logically be applied with respect to navigation use of the project.

Navigation

To justify charging a substantial part of the cost of Norris, Wheeler and Wilson Dams to non-existent navigation, the TVA Committee on Financial Policy has painted a rosy picture of prospective regional industrial development through availability of water transportation. If improvement of rivers for navigation had never been tried before in the Mississippi Valley or if improvement of rivers in this area in recent times had been followed by healthy commerce and industrial development, there might be excuse for such a prospectus, but the program

has been tried time and again in the past fifty years and its record discourages the assumption that positive overall benefits will result.

Any transportation saving through improvement of waterways must be looked at from an overall viewpoint since the funds for such improvement come from the National Treasury. River cities, because of Interstate Commerce Commission rate regulations, may get lower rail rates as a result of river improvement but this is a subsidy at the general expense and provides no overall benefit unless there results greater overall transportation efficiency or economy in the combined water, rail and highway transportation services than existed before the river improvement was made.

From the history of water borne commerce on inland rivers it does not appear that improvement of the navigability of the Tennessee will dispense with the need for any of the rail or highway facilities now serving that region. If river traffic did develop, its cost would plainly exceed the increment cost to the railroads and highways of carrying all the traffic. The overall cost of transportation serving the area will therefore have been increased.

The origination and destination of most commodities which might be shipped by inland rivers involve the use of truck or rail transportation and, because a large part of the cost of transportation consists in handling charges, loading and unloading, there is little incentive to use the river transportation. Therefore navigation on the Mississippi and its improved tributaries is largely confined to craft operated by the Federal Government or craft carrying supplies for the construction or repair of government projects, miscellaneous pleasure craft and a limited amount of special commerce that gain some advantage through the use of the waterway. Commerce in government-owned barge lines that does not pay operating expenses can hardly be credited to the cost of dams as an economic benefit. The remaining river traffic could support practically no charges; in fact, it would disappear if even small charges were applied. A good way to test the actual navigation benefits would be to put a lockage charge on vessels passing through the locks in the Tennessee dams as the former Chairman of the TVA at one time proposed,[19] and as is done in the Panama Canal. This would soon show how much river navigation could pay. It would take a substantial toll charge and volume of traffic merely to pay the costs of providing and operating the locks alone, without assuming any part of the cost of the dams and reservoirs.

Many persons in discussing the multiple benefits of the TVA project have pointed out that a report of the Army Engineers to Congress some years ago estimated that 9-foot navigation could be extended from the mouth of the river to Knoxville by a series of low dams at a cost of less than $75,000,000.[20] Using this figure they have attempted to determine what part of the cost of the TVA's projected expenditure of $521,000,000[21] for dams in the Tennessee and certain of its tributaries could properly be assigned to navigation.

The TVA allocation report for Norris, Wheeler and Wilson Dams used this earlier report of the Army Engineers in accordance with its "alternative justifiable expenditure theory" as a basis for the joint investment allocated to navigation. For its purposes, however, it proceeded to raise the estimate of the Army Engineers, who have been building navigation dams for a century, from $8,128,000 to $23,373,000, a raise of about 200 per cent. It then proceeded to assume that these high cost alternative navigation dams would have been a justifiable expenditure.

But the fact that 9-foot navigation to Knoxville could be provided for $75,000,000 did not mean that such an expenditure would be economic, that is, that the prospective benefits would stand that expenditure. Major R. W. Putnam, formerly U. S. District Engineer in Chicago and now a consulting engineer on navigation and waterways, estimated, on an optimistic basis in the light of the history of inland waterways, that the savings in transportation costs based upon the amount of tonnage which might be expected to develop within the next thirty years by reason of the series of low navigation dams on the Tennessee would justify an investment of $35,600,000, or less than half of the estimated $75,000,000 cost of the dam.[22] He estimated that the TVA plan of high dams and large pools would effect a saving in transportation costs on commerce to be developed in the next thirty years which would justify an expenditure of $48,000,000, or about 10 per cent of the $473,650,000 then estimated to be the cost of the TVA project.[22]

Norris Dam itself can have no practical navigation value. It has no locks and therefore constitutes a barrier to floating log rafts or other possible navigation at that point. After the main river dams are built, released water from Norris Dam can have no navigation value and there is no chance of any significant navigation developing before these dams are built. The Chief of Engineers, U. S. Army, in testifying before the House Military Affairs Committee in 1932,[23] when asked if the proposed Cove Creek Dam (later Norris Dam) were a feasible proposition for navigation purposes only, replied, "No, by no means," that he would never think of building a reservoir up there for navigation purposes only. When asked, "The navigation of the river is possible with the low dams that you contemplate?" he replied, "Exactly, and that is the cheapest way to get it, working for navigation only."

Pending the development of bona fide benefits to commerce, only the cost of locks at Wheeler and Wilson Dams should reasonably be credited to navigation, if they are to be accounted as a sound business enterprise which is to be used as a yardstick of the fairness of charges by other sound business enterprises. Later if real benefits or revenues were to arise from bona fide commerce, these should be assessed, the power charges credited, and rates reduced proportionately.

Fertilizer

The Committee on Financial Policy has omitted allocating a part of the common expenditures to fertilizer on the ground that fertilizer operations are being currently charged for services rendered by other departments of the Authority. This shows a radical change of program, a change indicated also by the switch from the statutory requirement that nitrates be manufactured to an experimental program for the development of phosphates. In its earlier estimates of revenue the TVA guessed that by 1935 it would have a revenue from the sale of fertilizer of $570,000 and in 1936 a revenue of $1,340,000.[24] These revenues did not materialize and the charging of fertilizer operations for services rendered by other departments of the Authority is equivalent to charging off part of the cost of dams to fertilizer without corresponding income. As in the case of national defense and in the case of navigation, this charge-off should be deferred until such time as, and to the extent that, revenues from the sale of fertilizer may have been realized. If

the TVA projects were being managed on a business basis, when income from fertilizer had actually developed, power charges would be relieved of a corresponding share of the burden of costs and rate reductions would then be granted.

Flood Control

The TVA Committee on Financial Policy found that $2,600,000 out of a scaled down cost of $94,125,671 for Norris, Wheeler and Wilson Dams was single purpose investment for flood control and that flood control should be charged with an additional $15,870,627 as its share of the remaining cost, making a total investment charged to flood control of $18,470,627.

There are two important tests of the flood control value of the TVA reservoirs: First, the benefits in the Tennessee Valley itself and, second, the benefits in the Mississippi Valley. The cost of the dams can properly be credited only with the actual reduction occasioned by them in the cost of alternative flood control measures in the Tennessee and Mississippi River Valleys. Such benefits, as will be pointed out later, will be very small compared with the value of the reservoirs for power development. It is doubtful that the flood control storage now contemplated at these dams will continue to be preserved in actual practice or that they will be seriously relied upon to reduce maximum flood heights in the planning and maintaining of flood control projects on these two rivers.

In the Tennessee Valley itself the principal point of danger of flood damage is the city of Chattanooga. The TVA project as designed affords little flood protection to this city whether storage capacity is reserved for flood control or not. If Chattanooga is to be protected from extreme high floods, it will still require extensive dikes. In fact the city is now asking the PWA for $14,800,000 for dikes to withstand a 60-foot flood height, stating that the effect of the TVA dams will be to reduce the estimated maximum flood height at that city by only 4 feet.[25] Without this 4-foot reduction the cost of the dike would perhaps have been two or three million dollars greater. Norris Dam would share with the proposed Fontana Dam the credit for this relatively small reduction.

No other flood control benefit of material consequence in the Tennessee Valley can be claimed for the TVA dams because they will have drowned out most of the rich bottom farm lands where flood damage used to occur. The permanent drowning out of farms, villages and other improvements in river basins is one way of curing flood damage but it is a destruction rather than a conservation measure and must be treated as a debit, not a credit, to flood control. Already there have developed in the Tennessee Valley what are called "ghost towns," so called because the farm lands which supported them have been drowned out. Cities and counties have begun to ask for compensation because of lost tax revenues, lost population, lost accessibility, etc. As for benefit to flood control in the alluvial valley of the Mississippi River, upon which the TVA in its report has leaned heavily for support of its allocation to flood control, Norris, Wheeler and Wilson Dams are too far away from the main stem of the Mississippi to have any pronounced influence on its flood stages. The Chairman of the House Flood Control Committee estimated that these three dams reduced the crest of the record breaking 1937 flood at Cairo, Illinois, by only one inch.[26] Most of the flood control value of the Tennessee reservoirs for Mississippi flood control must be assigned to the proposed Gilbertsville Dam near the mouth of the Tennessee. Very little could be credited to the three dams that are the subject of this TVA allocation report.

The small value of Tennessee River reservoirs for Mississippi flood control and the conflict between purposes was stated in a report to the Chief of Engineers, U. S. Army, by Major L. H. Watkins, District Engineer at Chattanooga, Tennessee, dated March 30, 1929, in which he said:[27]

"While the amount of water held out by reservoirs in the Tennessee River Basin appears large when compared to flood flows in the Tennessee River Basin, this amount is small compared to flood flows of the Mississippi, and studies made by the Board preparing plans for flood control of the Mississippi indicate that the waters held out by flood reservoirs of this stream would not have a very great effect on floods of the Mississippi, and as reservoirs used primarily for flood control of the Mississippi would require the use of sites necessary for the proper development of the Tennessee River for navigation, water power, and flood control, they would prevent the proper development of navigation, water power and flood control in this basin."

The TVA Committee on Financial Policy, in applying its "alternative justifiable expenditure theory," found that single purpose flood control storage on the Tennessee would cost $18 per acre-foot and used this as a basis for allocating the cost of the three dams to flood control. 2,020,000 acre-feet of flood control storage to be reserved at Norris Dam, at $18 per acre-foot, according to this calculation, would have a value of $36,360,000. The Committee ignored the fact that the U. S. Reclamation Service found that a flood control dam at Norris Dam site could be built for $7,150,000,[28] or one-fifth of its "alternative justifiable" figure.

The Committee, in relying heavily upon Mississippi flood control benefits for justifying its flood control allocation, ignored a long series of reports of Army Engineers which would show that the three dams under consideration would have little effect in reducing the cost of Mississippi flood control works and that the adopted alternative flood control plan of levees and floodways could provide the same benefits for a fraction of the cost. The Committee quoted a report of the Chief of Engineers in 1935[29] in support of its discussion, but failed to add that the said report, in discussing a comprehensive system of reservoirs, said that the direct benefits at the present time were not commensurate with the cost.

The flood control project adopted by Congress for the protection of the Mississippi Valley as yet has not been modified by reason of the TVA dams built and projected, and the situation is such that no flood control agency charged with the responsibility of protecting the alluvial valley from floods could feel justified in materially reducing the size and scope of that project on the strength of plans that have been stated for reserving 10,000,000 acre-feet of storage for flood waters in the TVA reservoirs. Any actual benefit would undoubtedly be treated as an additional factor of safety over and above the safety factor already adopted as a matter of judgment. If this reserved capacity could be definitely relied upon at all times, and if human minds could foretell several days ahead when rains would stop falling, so that the effect of this storage capacity would surely be applied to reduce Mississippi flood crests, 10,000,000 acre-feet of storage on the Tennessee could reduce the flood height at Cairo, Illinois, according to an engineer of the Mississippi River Commission, by 1.6 feet[30]; according to a hydraulic engineer of the TVA, it could have re-

duced the 1937 flood at Cairo, Illinois, by 2 feet[31]; and, according to a report of the Chief of Army Engineers, this could reduce a maximum flood height at Arkansas City by about 6 inches[32]. The reduction further downstream would be less in proportion. However, because floods of the Mississippi may be within a few inches of the crest height for several weeks and because of storm characteristics, the possibilities are considerable that the operation of the Tennessee reservoirs would be wrongly timed to reduce a flood crest. This is an eventuality that Mississippi flood control works would have to allow for.

On several occasions in times past, after rains had fallen on the tributaries above the alluvial valley sufficient to create a large flood, heavy rains from a storm following in the path of previous storms but falling on the main stem of the Mississippi River and in the lower reaches of the Yazoo, Arkansas, White and St. Francis tributaries have added several feet to the crest of the flood already in the Mississippi, their flood waters being superimposed on the flood already in the river.[33] This characteristic minimizes the value of the TVA dams for controlling flood heights in the alluvial valley and minimizes their usefulness for reducing the size, extent and cost of flood control works in that valley.

A recent statement of the Chief of Engineers says that by cutting off the bends in the river, done at a cost of a few thousand dollars, flood levels in the middle sections of the alluvial valley have been reduced from 4 feet at Vicksburg to 10 feet at Arkansas City.[34] He announces that these cut-offs will be extended to the mouth of the Ohio River at Cairo, Illinois. This restores the river to its former flood ratings and will render still less important any possible one or two ft. reductions in flood heights on the Mississippi River through the operation of flood control storage reservoirs on the Tennessee.

The improbability that flood control storage will be preserved in the TVA reservoirs at all times and will be available when actually needed for flood control is apparent from a consideration of the effect of reserving this storage upon the firm power capacity of the dams. In critical dry years it would be preserved at a big sacrifice of the valuable firm power capacity of the dams. Against this would be credited relatively small, uncertain and unrealized flood control benefits. It is an easy matter now when the TVA generators are only partially loaded to follow any flood storage rules that may be set up on paper, but the situation will be very different when the generating stations have become loaded to their capacity, for drouth and very low water are experienced in the Tennessee River much more frequently than extreme high floods. The maximum flood in the middle Tennessee occurred over sixty years ago and droughts have been experienced every few years. At some future time when the TVA shall have contracted out all of the firm power capacity of its proposed dams the natural growth of load of its customers will force it to push aside flood storage rules of no immediate importance to meet the immediate necessity for more firm generating capacity.

In testifying before the House Subcommittee on Appropriations in April, 1937, Dr. Arthur E. Morgan said:[35]

"My chief fear in combining flood control and power is that in later years, in times of dry weather, power interests begin to encroach upon flood-control storage, and then if there should be a big flood, the storage space might be in use for navigation and power when it should have been kept empty."

In speaking before the National Rivers and Harbors Congress at Washington on April 26, 1937, Dr. Morgan said:

"* * * Power storage is needed every year, whereas great floods may occur at long intervals. There is temptation to take a chance on floods in order to get the immediate advantage of additional storage for power. The operation of unified river control should not be dominated by any interest, but by inclusive, overall understanding of the problem. If the system is dominated for power, then flood control capacity will be usurped, and will be missing when urgently needed. Already at the Norris Dam we have been under pressure and have received bad advice to encroach on flood storage for immediate power benefits. In the administration of these combined purpose projects we must guard against the one track minds, the ignorant persons and the demagogues, who would take a chance of a flood catastrophe for the sake of immediate income for power."

Newspaper reports of the recent flood on the Lower Colorado River in Texas illustrate again the inherent conflict between the use of dams for flood control and for power development. The flood in this river found the reservoir behind Buchanan Dam filled for power development and the result was worse damage than if there had been no dam at all.[36]

Pending ample demonstration that flood control storage will be preserved under all circumstances, no part of the cost of the TVA dams should be allocated for flood control benefits. When this may have been demonstrated, and this will require a number of years, the cost of these dams should then be credited only with the actual reduction in the cost of the alternative flood control measures. Norris Dam should then be credited with perhaps one and a half or two million dollars as it share of a reduction in the cost of flood protection dikes at Chattanooga. Any measurable reduction in the cost of flood control works of the adopted Mississippi River project should be credited principally to Gilbertsville Dam. The share of Norris, Wheeler and Wilson Dams would certainly be negligible.

Fixed Charges

A simple device for making an uneconomic hydroelectric project appear feasible is to scale down the fixed charges against the project. According to experience long standing, over 90 per cent of the annual cost of generating power at hydroelectric stations is made up of interest on investment, depreciation or amortization or both, taxes and insurance.[37] Less than 10 per cent of the annual cost is chargeable to labor, supplies, etc.

Fixed charges may for a time be ignored in part or altogether, but they are real and in due time always assert their full force. The statement of fixed charges by engineers and accountants has always been approximate and somewhat arbitrary but their order of magnitude for self-supporting projects has been determined by a long experience record with financial difficulties, bankruptcies and abandonments of operations.

It has been the experience of the engineering profession that to be self-supporting and to be able to attract new capital for further expansion, an engineering project must produce revenue over and above its annual operating expenses in the amount of 12 to 14 per cent annually of the capital investment in the project.[38] When business in America has been growing and expanding this has been the amount of these charges. A majority of the leading engineers of the country today would assign 12 or 12½ per cent as the proper amount of annual fixed charges on the capital investment in a healthy business. Any

reduction over a period of years in the average cost of money or in depreciation rates has been absorbed in greatly increased tax rates.

In arriving at a figure for fixed charges of 12 to 12½ per cent, engineers have considered the fact that interest rates, though low at certain times, have varied considerably during a period as long as the probable life of a hydroelectric generating station. This has been true whether money has been borrowed by private enterprise or by the government. The average cost of money in accumulating the vast public debt of the Federal Treasury has been greatly in excess of the rate for short term government financing of the past few years. At the same time the cost of money to the Treasury is considerably more than the bare interest rates that the government pays, for it must be charged a proper share of the great expense of the fiscal machinery of the Federal government, which adds substantially to government financing costs.

Depreciation goes on whether a project is owned by the government or by private enterprise. The same is true of insurance costs for the various risks of the enterprise are substantially the same in either case, however they may be covered.

So far as taxes are concerned, their sole purpose is to defray the costs of government and these costs go on whether or not a specific piece of property is exempted or largely exempted therefrom. If exempted, this simply means that a larger share of the burden is distributed on property and individuals not so favored with exemption. The full tax costs are presented in either case, although they may not be apparent, and for yardstick purposes must be included.

That very little real difference exists in the amount of fixed charges against an engineering project whether built by a public or private agency, regardless of how the charges may be covered up by incomplete accounting, is apparent from the financial reports of the Ontario Hydro Commission which for many years has been operating a group of hydroelectric generating plants and a system of transmission lines and substations. This is a public enterprise which has been and still is aided and subsidized in various ways at the expense of the taxpayer, and its accounting does not reveal all the elements of its fixed charges. Although at first required by law to amortize its investment in 30 years, according to its 30th Annual Report, its outstanding debt is still 85 per cent of its capital investment[39]; and part of this reduction was attained by unloading on the provincial treasury certain bonded indebtedness to be written off at the expense of the taxpayer.[39]

The Ontario Hydro Commission charges municipalities and rural power districts 4.51 per cent for interest and 7.7 per cent for total fixed charges including interest.[40] The Commission actually paid in 1937 on outstanding indebtedness interest of 3.78 per cent.[41] Its charges to municipalities undoubtedly reflect average interest rates over a period of years. For yardstick purposes, to the 7.7 per cent should be added taxes at the rate paid by the electric utilities in the United States, which is 2.65 per cent ($330,000,000 taxes annually on a twelve and a half billion dollar investment) and insurance costs at .3 per cent. This gives a total fixed charge of 10.65 per cent. This amount, certainly not all of true costs, is very much higher than the figure for fixed charges which has been used by the TVA engineers, and far above that used by the Federal Power Commission in the case of Bonneville cost accounting.

In a discussion published in the June, 1938, Proceedings of the American Society of Civil Engineers, Mr. H. A. Wiersema, General Office Engineer of the TVA, has calculated that fixed charges at 3.8 per cent on the investment in seven of the TVA dams already built or being built will be enough to consider as paying interest charges or amortizing the whole investment in 50 years.[42] Interest charges made up 2.9 of the 3.8 per cent. He feels this amount to be more than generous, that really interest charges could be taken at 1.55 per cent.[43] These or similar figures were evidently the ones which supported the statement in the third paragraph of Chairman Harcourt A. Morgan's letter of June 9 to the President, concerning the ability of the power revenues from Norris, Wheeler and Wilson Dams to cover the costs of power operation and to return in 30 years the entire investment allocated to navigation and flood control.

Since fixed charges comprise over 90 per cent of the cost of generating water power, the effect of using 3.8 per cent for fixed charges in place of 12 per cent is to wipe out a large part of the calculated cost of such energy. It helps to make established power rates appear to be ample and compensatory.

Evidently the Ontario Hydro Commission, in its beginning, also doubted the full reality of these fixed charges, or ignored them in part, for initially it fixed its power rates even lower than those of the TVA.[44] But in the course of time it found it necessary to double its original power charges.

Miscellaneous Comments

In the face of a national policy of large scale lending-spending in the hope of relieving want and unemployment, it may seem academic if not absurd to make a fuss over the close accounting of a few hundred millions of dollars expended by the TVA, when like treatment is not required of other billions of dollars gathered from the taxpayer and paid out by the Federal Treasury. There is no acurate accounting for funds spent on straight navigation, nor on straight flood control projects, nor on the general run of WPA projects, etc. The TVA project, however, was set up to be a yardstick project to measure the fairness of rates of existing electric utilities; and in submitting an allocation of cost, as required by Congress, the TVA purports to have submitted a complete and accurate accounting. Its report of allocated costs and its estimate of return on investment must be expected therefore to meet generally accepted accounting standards of sound business. This it seriously fails to do.

The basic difficulty confronted by the TVA Committee on Financial Policy in making its allocation report was the fact that navigation, flood control and national defense were merely constitutional pegs upon which power legislation was hung, thus making necessary the use of fine-spun arguments to give the appearance of reality to the unreal. A second great difficulty confronting the committee was the fact that the TVA almost five years previously had fixed its electric rates at politically expedient levels, long before it knew or appreciated what the actual cost of power from this project would be. It now develops that these rates will cover only a small part of the true cost. Obviously, elaborate discussion is needed to gloss over this situation.

Dam Costs Compared

Wilson Dam is twice as big as Wheeler Dam. It has an operating head of 90 feet compared with 53 feet at Wheeler Dam. It contains 1,240,500 cubic yards of concrete against 630,000 at Wheeler.[45] It required 1,387,500 cubic yards of excavation against 545,000

cubic yards at Wheeler. The coffer dam problem at Wilson Dam was much more difficult than at Wheeler. It has an installed capacity of 184,000 kilowatts whereas Wheeler has present installed capacity of only 64,000 kilowatts.[46] The ultimate capacity of Wilson Dam is to be 444,000 kilowatts and the ultimate capacity of Wheeler Dam is to be 256,000 kilowatts.[47] Yet Wilson Dam is assigned a total cost of only $30,120,009 and Wheeler Dam is assigned a total cost of $32,473,542.

Depreciation at Wilson Dam Before and After TVA

The construction cost of Wilson Dam including interest at the rate paid by the government during construction was $59,775,000. It went into operation about seven years before it was turned over to the TVA at the end of May, 1933. If at that date Wilson Dam was worth only $31,300,000 as officially determined by the TVA, the depreciation rate at this dam for the first seven years of operation, on a sinking fund basis with interest at 4½ per cent, was 5.93 per cent per annum. By contrast, the General Office Engineer of the TVA has taken 0.9 per cent as the rate of depreciation,[48] on a sinking fund basis, for the TVA projects, and the TVA in its annual reports heretofore has shown no charges whatever for depreciation. If the depreciation rate prior to 1933 had been continued Wilson Dam would be entirely depreciated by the end of 1939, next year.

Three Dams Make Best Showing

The three dams, Norris, Wheeler and Wilson are credited in the allocation report with an installed capacity of 348,000 kilowatts, but in testifying in December, 1937, before a Subcommittee of the House Appropriations Committee, the initial power installation of the three dams was reported to be 412,000 kilowatts and the initial capacity of the entire 11 dams of the approved project was reported to be 697,000 kilowatts.[49] The cost for the initial installation at Norris, Wheeler and Wilson Dams was reported to be $104,511,141, out of a total for all 11 dams of $443,573,370.[49] The three dams with 60 per cent of the initial power installation are estimated to cost 24.5 per cent of the total initial cost. On the basis of ultimate power installation and ultimate cost, the three dams will have 41.6 per cent of the total installed capacity and will cost 26.7 per cent of the total cost of the 11 dams. Thus it is seen that the three dams, which are the subject of this allocation report, make by far a better showing as feasible engineering projects than the other dams will make. When the allocation report is submitted for the 11 dams, a much heavier percentage of cost will have to be charged off to theoretical navigation and flood control benefits in attempting to justify a huge but uneconomic engineering project.

Power Dams Only Part of Total Cost

Although the TVA allocation report is properly confined to dams and related structures, the Authority in transmitting the report says that power revenues will return the cost of the investment in a specified number of years. This brings in also the matter of cost of transmission lines, substations and standby steam plans for these will be necessary if the TVA carries out the power supply business it has launched into. The Ontario Hydro Commission, which is set up to do the same kind of power business, reports an investment in transmission lines and substations of $69.08 per kilowatt of installed generating capacity for owned power plants and purchased power.[50] Up to June 30, 1937, the TVA had already expended $14,551,539 on transmission and distribution equipment and estimated that its expenditure up to June 30, 1939, would amount to $26,215,000.[51] This amount covered the use of only a little over one-sixth[52] of its estimated ultimate installed generating capacity.

The Tennessee is subject to wide annual variations in stream flow. Private electric utilities in that same general territory have found it necessary to install a large percentage of standby steam capacity in order to give their customers the necessary assurance of reliable service. The TVA, if it assumes similar responsibility, will have to make similar provisions for reliability of power supply. It already has a steam standby plant at Muscle Shoals built during the War at a cost of $12,000,000,[53] and it has acquired some small steam plants which it holds for standby purposes. This requirement for reliable service will add still more huge sums to the capital investment of the TVA and in turn will render still less compensatory its established power rates.

APPENDIX

NOTES AND REFERENCES FOR COMMENTS ON TVA's ALLOCATION OF INVESTMENT OF NORRIS, WHEELER AND WILSON DAMS*

**TVA's allocation submitted to the President for Approval, June 17, 1938.*

1. Thirteenth Annual Report of the Electricity Commissioners. p 67.
2. Hearings Before the Subcommittee of the Committee on Appropriations House of Representatives, 75th Congress 1st Session on The Second Deficiency Appropriation Bill for 1937. p 491.
3. Testimony of David Lilienthal before TVA Investigating Committee, Knoxville Journal, July 27, 1938.
4. Testimony of David Lilienthal before TVA Investigating Committee, Knoxville News Sentinel, July 26, 1938.
5. Hearings Before the Subcommittee of the Committee on Appropriations House of Representatives, 75th Congress 2nd Session, on Independent Offices Appropriation Bill for 1939. p 919.
6. See Exhibit (A), Bond Yields, U. S. Treasury Dept. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)
7. See Exhibit (B), Cost of Wilson Dam. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)
8. TVA Allocation Report, June 9, 1938. p 19.
9. TVA Allocation Report, June 9, 1938. p 18 for Cost. See also TVA Release August 1, 1936, for date of completion.
10. See Exhibit (C), Cost of Norris Dam. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G, and H, noted in this appendix, by request to the Edison Electric Institute.)
11. TVA Allocation Report, June 9, 1938. p 19.
12. See Exhibit (D), Cost of Wheeler Dam. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)
13. Chattanooga News, March 1, 1935.
14. Hearings Before the Subcommittee of the Committee on Appropriations U. S. Senate, 73rd Congress 2nd Session on H.R. 9830, Deficiency Appropriation Bill, fiscal year 1934. pp 262-263.
15. Hearings Before the Subcommittee of House Committee on Appropriations in Charge of Deficiency Appropriations, 74th Congress 2nd Session. Part I, p 284.
16. Hearings Before the Subcommittee of House Committee on Appropriations in Charge of Deficiency Appropriations, 73rd Congress 2nd Session. p 169.
17. Hearings Before the Subcommittee of the House Committee on Appropriations in Charge of Deficiency Appropriations, 75th Congress 1st Session on the Second Deficiency Appropriation Bill for 1937. p 451.
18. "The Federal Water Power Act" (June 10, 20) U. S. Code Annotated Title 16, S 804-805. p 230.

(*Continued on page* 504)

Final Plans for the Second National Accounting Conference

To be Held Under the Joint Auspices of the American Gas Association and the Edison Electric Institute

THE plans for the Joint Accounting Conference are rapidly nearing completion. The Conference will be held at the Palmer House, Chicago, Ill., on Dec. 13 and 14. In addition, the specialized accounting committees will hold separate meetings on Monday, Dec. 12. A condensed tentative program is printed in this issue.

Following the success of last year's accounting conference held in Detroit, and as a result of the enthusiasm and renewed interest in accounting activities displayed on that occasion, the accounting sections of the American Gas Association and the Edison Electric Institute have teamed together in sponsoring a conference that will be wholly devoted to the major and more important problems now facing the respective industries. In addition, the American Institute of Accountants and the Controllers Institute of America are being represented on the program. The selection of Chicago as the meeting place of the Conference was made on account of its central location and accessibility to the accountants throughout the country. Many speakers with national reputations will address the Conference. This, together with a discussion of many topics that vitally affect the pocketbooks of the utilities' customers and the evidence on every hand of enthusiastic interest on the part of the utility accountants and utility managements make it certain that the success of this year's conference is already assured. In fact, it is probable that a new record in point of attendance for a gathering of American accountants will be set.

Highlights of Conference

Generally, three outstanding themes will dominate the discussions:

1. Economies in Accounting Processes.
2. Plant Accounting and Depreciation Problems.
3. Accounting Education, Training and Ethics.

Questions of taxation accounting will also be given prominence, as well as the use of budgets from the management's viewpoint.

Economies in Accounting Processes

The subject of economies in accounting processes presents one of the most serious problems facing the utility industry today. Paring down the cost of accounting may be said to be the principal task of all leading accountants at this time, in view of the ever mounting toll exacted from the revenue received from utility customers by recording transactions. This is emphasized by general recognition of the newly added burdens imposed on utility accounting by the requirements of various governmental agencies. Responsibility has been placed on the accountant to devise means of meeting past and new accounting burdens without prohibitive increases in accounting costs.

The men whose efforts have made these National Accounting Conferences possible believe that accountants can better meet this responsibility by discussion of the various processes now in vogue. Comparative analysis of the results of others on a national and sectional basis rather than confined solely and continuously to the sphere of single corporate entities, will result in a stimulus and incentive that will ultimately mean real savings in the operating costs of the concerns who cooperate in these activities.

Frequently when managements make comparisons of costs they find wide variations, often because of differences in accounting practices. It not infrequently occurs that accounting costs vary, comparatively, in excess of 100 per cent. For example, commercial accounting costs, which include indexing, collecting and billing, have often been known to swing from $1.85 per customer per year to upwards of $4.00 per customer per year. Are these differences due to local conditions such as labor costs; are they due to accounting practice variations, or are the savings achieved by better and simpler means of accomplishing this necessary task? Likewise, the costs of plant accounting have been steadily on the increase. Is it not up to the accounting people in the industry to bend every effort in ascertaining the true facts and the most economical processes, thus enabling the management to get the resulting benefits?

Mr. Robert A. Hornby, vice-president of the Pacific Lighting Company, San Francisco, Calif., will discuss the matter of Commercial Department Economies and will give the conference the benefits of his experience in this field. Some of the by-products of the commercial department job standards investigation which Mr. Hornby will amplify at Chicago are as follows:

(a) Measuring and adoption of the better of two bookkeeping systems.

(b) The uncovering and elimination of inefficient and often irritating routines.

(c) Job analysis and compensation according to work done, rather than title.

INFORMAL DINNER
Palmer House
Red Lacquer Room
Ballroom Floor
Tuesday, December 13th
7:00 P.M.

●

Toastmaster:
Major Alexander Forward

Guest Speakers:

Dr. H. B. Dorau—
"Impact of Economics on Accounting"

Mr. Henry C. Perry—
"Accounting After the First 100 Years"

Mr. B. F. Weadock—
"The Accountants' New Responsibilities"

●

Tickets available at registration desk

(d) Group conferences for supervisors on suggestions for supervising and application of personnel practices.

(e) First results.

Plant Accounting and Depreciation Problems

Many new technical problems in this field confront the industry at this time. Healthy discussion, exchange of views, and expert opinion regarding the best and simplest means of handling these tasks are a fruitful source of benefit to the managements of the respective companies. These specialized fields are entirely new to many of our accountants. At least as regards some of the more difficult questions which now call for consultation. A few case problems will serve to illustrate some of the matters to be discussed at Chicago:

1. "X" Company, in order to determine the original cost of its general plant, including office furniture, fixtures, tools, equipment, automobiles, laboratories, stores, and shop equipment, etc., makes a field inventory of the properties falling within these classifications, and by resorting to cost data obtained from vouchers, books of account, and other authoritative sources, prices the inventory with the result that the cost of the priced inventory is substantially in excess of the aggregate reflected in the books.

2. "Y" Company desires to adjust its books in accordance with an original cost determination of its distribution properties. The result of a priced inventory is substantially below book cost. The aggregate of the book cost is reflected by the appropriate plant accounts. The inventory has been priced on the basis of an approximation of the dates applied to the various units of the physical property and unit cost determined each year as far back as authentic data can be obtained from the books.

3. Taking the above situation with exactly reversed figures so that the priced inventories thus arrived at exceed the books, a problem similar to No. 1 above stated, what would be the appropriate methods of adjustment?

4. "Z" Company contracts to supply a railroad with power, and in connection therewith takes over the railroad's plant, to be used mainly for standby purposes. When first dedicated to public use (by the railroad) the plant cost considerably in excess of the amount for which it was acquired by "Z" Company. The plant is still in good condition although some ten or fifteen years old. What are the accounting procedures?

These and many other questions are before the accounting people for a solution.

Depreciation

Can industry accountants and managements look forward to a more satisfactory solution of the depreciation problem, or is the industry to be confronted with requirements based on theoretical formulae rather than upon sound business experience, which will confuse rather than improve the situation? Conclusions not based on correct analysis, and practical experience can cause the industry and its customers very great damage. On the other hand a careful restudying of the experience record of the past decades may lead to improvement.

The industry needs more factual information. What has been the actual past experience of the industry? What have been the actual causes of retirements? What is the difference between accounting for depreciation and determination of loss in value? Is it possible to ultimately obtain more clarity and common-sense understanding in dealing with this extremely difficult subject?

Accounting Education, Ethics and Training

For the past decade and more, many educational institutions throughout the country have specialized in training accountants in business administration. Are these accountants being trained to keep a very watchful eye on the costs of the processes which may ultimately come under their supervision? Are they educated as to the solution of some of the very real and practical problems of a technical nature now a part of the accountants' responsibilities? They are certain to be trained in the rudiments of bookkeeping technique, but are they to have inculcated in them the higher ideals of the accounting profession in keeping accounts the way they should be kept.

What are the facts, and do those engaged in the practice of accounting, inside and outside of the industry, keep up to date with the progress of accounting education in this respect? Cannot the accounting work in the industry rise above the standards and training taught at school?

Foremost Authorities

The accountants participating in the conference will have the privilege and opportunity of listening to some of the foremost authorities in the accounting and related fields.

Mr. Charles W. Smith, Chief, Bureau of Accounts, Finance and Rates, Federal Power Commission, Washington, D. C., and Dr. E. W. Morehouse, of the Public Service Commission of Wisconsin, and Chairman of the Accounting Committee of the National Association of Railroad and Utilities Commissioners need no introduction. They will address the conference on the following subjects:

Mr. Smith—"Problems in Uniform Utility Accounting."

Dr. Morehouse—"Federal and State Regulations, and Management Attitudes."

Mr. George Vesselago, who has been connected for many years with one of the leading engineering firms of the country and has had personal charge of installing the continuing property records for more than a score of utilities, comprising electric, gas and water companies, will discuss his experiences. Legal aspects of the new accounting classifications will be the theme of F. M. Hunter, Esq., a prominent Philadelphia lawyer. Obsolescence in its engineering aspects, always a thorny problem, will be featured by Mr. D. M. Jones of the General Electric Company. Addresses will also be made by Mr. E. C. Christensen of Price, Waterhouse & Co., representing the American Institute of Accountants, and by a representative of the Controllers Institute of America.

Mr. Willard J. Graham, Associate Professor of Accounting, University of Chicago, will address the Conference on "Accounting Education, Ethics and Training."

Several other accounting and industry leaders will be included in the final program of the meeting.

Personal Contacts

It has always been the thought that the industry would benefit largely from a personal get-together of its key accountants. Many savings, measurable in dollars and cents, will result from the opportunities afforded during the Conference for discussions, outside the planned meetings. A general exchange of ideas, in regard to specific, actual problems, cannot but bear large dividends for the companies at home. These smaller problems cannot, in the nature of things, be made the subject of a featured talk, but the earnest accountant will find no trouble in "talking it over" with colleagues and discussing their successful, or at least attempted solutions of their pet problems.

The importance of the accounting topics to be presented and the need for their full discussion has been recognized by the policy-making bodies of both the electric and gas industries. The Conference will enjoy the fruits of this cooperation.

An address of welcome will be made by Mr. George F. Mitchell, president of The Peoples Gas Light & Coke Company of Chicago.

Major Alexander Forward, Managing Director of the American Gas Asso-

ciation will act as toastmaster at an informal dinner to be held Tuesday evening, December 13.

Dr. H. B. Dorau, Professor of Economics, New York University, and Mr. Bernard F. Weadock of the E.E.I. are the guest speakers at the dinner. Dr. Dorau will speak on "Impact of Economics on Accounting," and Mr. Weadock on "The Accountants' New Responsibilities."

It is desired to again stress that this Conference is devoted to serious work, and therefore no entertainment is planned beyond the informal dinner. No effort has been spared to make this Conference a worth-while affair and to impress the speakers with the importance of high-lighting those points which vitally affect the utilities' interest in accounting problems. Many new ideas will be disseminated, which, when translated into practice by the companies, will mean to them actual savings in dollars and cents.

Please make hotel reservations direct with the Palmer House, Chicago, Ill.

Tentative Agenda

Individual Accounting Committee Meetings

SEVERAL of the Edison Electric Institute Accounting Committees are scheduled to hold meetings in Chicago on Monday, Dec. 12. Some of these individual committee meetings will take the form of a series of planned round table discussions and will be open to all caring to attend; some will be open by invitation only, and others will be closed meetings, for members only.

Classification of Accounts Committee —E.E.I.

Chairman—R. B. CURRAN, The Connecticut Power Co., New London, Conn.

Vice Chairman—J. H. MORRELL, Niagara Hudson Power Corp., New York, N. Y.

The Classification of Accounts Committee will hold a closed meeting on Monday, Dec. 12 for members only in Room 18, Club Floor, starting at 9:30 A.M. However, Mr. Curran, the chairman, has indicated if an industry delegate has a particular problem or would like to obtain a consensus of opinion from the committee, the committee would be most happy to entertain such questions whether in writing or by personal appearance.

Customers' Relations, Commercial Accounting & Collections Committee—E.E.I.

Chairman—K. E. BOYLE, The Dayton Power & Light Co., Dayton, Ohio.

Vice Chairman—E. N. KELLER, Philadelphia Electric Co., Philadelphia, Pa.

This committee plans a full day meeting in Room 17, Club Floor, starting at 9:30 A.M., the first half hour of which will be devoted to committee members after which, or at 10:00 A.M., the meeting will be open to all caring to attend. The following outline will form the tentative agenda of that meeting. These subjects and others will be presented by papers followed by a round table discussion:

10:00 A. M.—Some of the Principal Problems Arising in the Operation of a Customer's Accounting Department for a Joint Gas and Electric Company.

(a) What economies in costs can be expected in a joint company as compared with a single service company.

11:30 A. M.—Advantages and Disadvantages of Rendering "Averaged Bills" when regular monthly meter reading is not obtained.

(a) What classes of accounts should be included in such a plan.

(b) To what extent does such a policy affect Customer Relations.

2:00 P. M.—Customers' Deposits vs. Credit.

(a) To what extent is it economical for a company to require Customers' Deposits.

(b) Who should be required to make deposits.

(c) The advantages of a credit policy which requires no deposits.

3:15 P. M.—The Pros and Cons of a Station vs. a Specialized Bookkeeping Plan in a Customers' Accounting Department.

(a) Which plan offers the greater possibilities for economical operation.

(b) Personnel requirements of each plan.

4:30 P. M.—Discussion of some problems encountered in properly Accounting for Federal 3% Electrical Energy Tax.

Depreciation Accounting Committees—Joint E.E.I. and AGA

Chairman—C. E. KOHLHEPP—Edison Electric Institute Committee.

Chairman—H. C. HASBROUCK, American Gas Association Committee.

The Depreciation Accounting Committees of both the Edison Electric Institute and the American Gas Association will meet at 9:30 A.M. in Room No. 9, Third Floor, in a closed meeting.

Plant Accounting & Records Committee—E.E.I.

Chairman—H. D. ANDERSON, American Gas & Electric Service Corp., New York City.

Vice Chairman—J. V. CLEARY, Consolidated Edison Co. of New York, Inc., New York City.

The Plant Accounting & Records Committee will hold an all-day meeting beginning at 9:30 A.M. in room 14, Club Floor. This meeting will be closed except for invited members of engineering staffs of member companies and others who may wish to bring important matters before the committee for consideration.

Purchasing, Stores & Transportation Committee—E.E.I.

Chairman—E. S. BROCK, Public Service Electric & Gas Co., Newark, N. J.

This committee plans a full day meeting in Room 10, Third Floor, starting at 9:30, the first half hour of which will be devoted to committee members only, after which the meeting will be open to all caring to attend. The following tentative program will form the agenda of that meeting. These subjects and others will be presented by papers followed by a round table discussion:

10:00 A.M.—Economies in taking physical Inventories of Materials and Supplies.

11:00 A.M.—Accounting for Transportation Expense.

12:00 A.M.—Use and Misuse of Blanket Purchase Orders.

2:00 P.M.—Salvage Operations and New Developments in Accounting for them.

3:00 P.M.—Establishing a Base for Materials and Supplies—Stores Expenses—Clearing Rates.

4:00 P.M.—Unit Packages.

5:00 P.M.—Charging to a Clearing Account Certain Minor Materials Designated as "Exempt Supplies."

Statistical Committee—E.E.I.

Chairman—CHARLES R. LANDRIGAN, The Detroit Edison Co., Detroit, Mich.

The Statistical Committe of the Edison Electric Institute has accepted an invitation from the Accounting Committee to hold a meeting concurrent with the accounting conference in Chicago. This meeting will be closed and is scheduled to start at 9:30 in Room 8, Third Floor.

Condensed Tentative Program

Second National Accounting Conference

Under the Joint Sponsorship of the

Edison Electric Institute and the American Gas Association

The Palmer House—Chicago, Illinois, December 12, 13, 14, 1938

Presiding—Bernard S. Rodey, Jr., Chairman EEI Committee H. A. Ehrmann, Chairman AGA Committee

Conference Office—Room 15 Club Floor (Fourth Floor Elevator)

Registration—Corridor adjacent Red Lacquer Room, Fourth Floor

MONDAY

Registration and Committee Meetings

8:30 A.M. Registration of members and industry delegates.

9:30 A.M. Committee Meetings

(See page 479 for agenda of tentative programs of open committee meetings)

Classification of Accounts—Chairman, R. B. Curran, (EEI)

Customers' Relations, Commercial Accounting and Collections—Chairman, K. E. Boyle (EEI)

Depreciation Accounting—Chairman, C. E. Kohlhepp (EEI) H. C. Hasbrouck (AGA)

Plant Accounting and Records—Chairman, H. D. Anderson (EEI)

Purchasing Stores and Transportation—Chairman, E. S. Brock (EEI)

Guest Committees

Statistical—Chairman, C. R. Landrigan (EEI)

TUESDAY MORNING

General Session—Red Lacquer Room

8:30 A.M. Registration of Members and Industry Delegates

9:30 A.M. Opening Remarks of Chairmen—B. S. Rodey, Jr., H. A. Ehrmann

Address of Welcome—George F. Mitchell

Accounting Organization Problems—L. L. Dyer

Elimination of Duplication of Reports to Governmental Bodies—W. T. Neel, W. G. Bourne, Jr

Accounting Education, Ethics, and Training—Willard J. Graham

Depreciation for Federal Income Taxes—R. C. Staebner

By-Product of a Commercial Department Job Standards Investigation—R. A. Hornby

TUESDAY AFTERNOON

2:00 P.M. Taxation Accounting—S. J. Barrett

Federal and State Regulations and Management Attitudes—Dr. E. W. Morehouse

Plant Accounting and Records

Comments on Continuing Property Records and Original Cost Determination—H. D. Anderson

Legal Aspects of New Uniform Accounting Systems—F. M. Hunter, Esq

Methods of Installing Continuing Property Records—G. M. Vesselago

Practical Experience in Original Cost Determination—H. M. Tickle

Perpetuation of Original Cost Records—J. V. Cleary

Coordination of the Accountant and the Engineer in the Determination of Original Cost—A. A. Lipschutz, H. P. Taylor

WEDNESDAY MORNING

9:00 A.M. Outline of Aims and Purposes of the Work of the Depreciation Committee—C. E. Kohlhepp

Causes of Property Retirements—H. C. Davidson

Depreciation Concepts and Principles—H. L. Gruehn

Present Views of Authority on Depreciation—H. C. Hasbrouck

Some Engineering Factors Affecting Obsolescence—D. M. Jones

Planned Floor Discussions—M. R. Scharff, R. A. Hornby, L. R. Nash and others.

The Auditor's Viewpoint of Public Utility Accounting—E. C. Christensen

The Budget; An Executive's Viewpoint—T. O. Kennedy

WEDNESDAY AFTERNOON

2:00 P.M. Materials and Supplies—Velocity and Salvage Operations—K. C. Campbell

Customer's Deposits—James A. Schultz

Problems in Uniform Utility Accounting—Charles W. Smith

An Accountant is Perplexed—Francis J. Brett

Closing Remarks

The Rural Electrification Job of Consumers Power Company

Consumers Power won the 1938 Thomas W. Martin award for Rural Electrification—This is an Abstract of the Report and Exhibit on which the award was based

CONSUMERS POWER COMPANY'S rural electrification activities are well described in the popular phrase—"Doing the Job for the Farmer." On the Company's part it means dedication of resources in facilities, materials and human energies to fulfilling this purpose.

In results, in customer satisfaction and in popular reaction, Consumers Power Company believes its progressive policies and constructive achievements constitute a useful contribution to the progress of rural electrification and submits this report of 1937 operations to substantiate the claim.

This Company led the country in rural extensions in 1936. In 1937 the Company again led—and did so by so large a margin of increase over its 1936 operations that there is set forth below a summary of 1937 results.

1937 Results

3,684 miles rural line built in 1937 (88% increase over 1936).

14,607 farms connected to NEW lines, 1937 (77% increase over 1936).

19,613 total rural customers connected in 1937.

1,079 kwhr sold per farm, average, 1937 (17% increase over 1936).

$35.32 average revenue per farm, 1937 (15½% increase over 1936).

3.27c average revenue per kwhr (1.2% decrease under 1936).

48% of all farms in service area now electrified (46% increase over 1936).

In addition to:

Liberal and popular construction plan.

Extensive cooperative activities.

Organization of state-wide rural service staff.

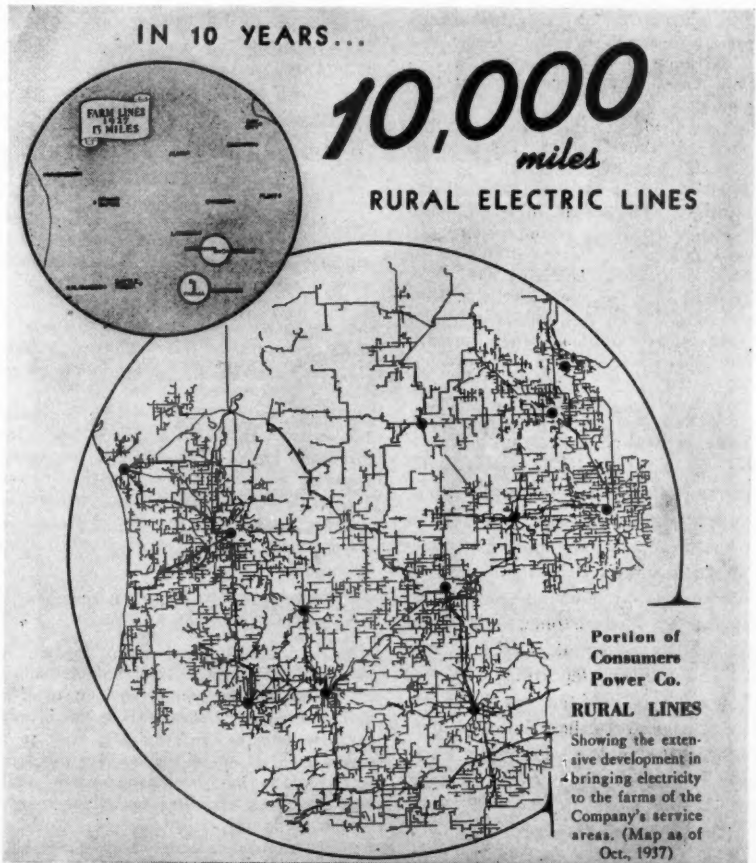
A plan is essential to a successful Rural Electrification program . . . a plan based on sound engineering and construction, businesslike extension and connection policies, and utilization and rate features that open the door to varied and economical application of the service.

Consumers Power Company submits this plan as a contribution to the progress of rural electrification . . . measured both by its successful functioning and by popular public acceptance.

The Plan

The Rural Electrification Plan as executed by the Company during 1937 was developed and perfected from the experiences and the plans that have been in effect since February, 1929. A basic principle of the plan, in conformity with previous plans, is to render rural service on the urban residential rate and extend service as rapidly as possible to rural people.

Each year since 1929, modifications have been made to liberalize the plan in order to obtain the Company's objective


IN 10 YEARS...
10,000
miles
RURAL ELECTRIC LINES
FARM LINES 1912 15 MILES
1
Portion of Consumers Power Co.
RURAL LINES
Showing the extensive development in bringing electricity to the farms of the Company's service areas. (Map as of Oct., 1937)

BRIEF OUTLINE OF CONSUMERS POWER COMPANY
(At December 31, 1937)

Total rural customers now served, approximately 80,000.

41,807 farms served. 10,739 miles farm lines in operation.

Company's service area exceeds 20,000 sq mi., includes 1,098 cities, villages and townships supplied with electricity or gas, or both. State-wide interconnected transmission system totals more than 2,400 circuit miles of lines operating at 22,000 to 140,000 volts. Electric generating capacity, 413,215 kw. Electric customers, 392,857.

90% of the farm land in the 19,000 sq mi. of rural area in the Company's territory is rated as marginal or poorer according to Michigan State College agricultural land classification. Yet the Company already supplies 46% of the farms in its territory.

of rendering service throughout its entire franchised area.

The essential features of the present plan are:

1. There must be an average of at least five farm customers, or the equivalent, per mile of line.
2. There must be a guaranteed revenue in the form of a monthly minimum payment of $12.50 per month per mile of line.
3. Each farm customer, or the equivalent, must install a three-wire service of at least 60 ampere capacity.
4. A grant of free right of way on private property for the pole line.
5. That the customers take the initiative in promoting extensions and securing right of way. The Company will furnish all necessary right of way papers.

Some of the noteworthy changes that have taken place since 1929 are:

1. Lower rates.
2. Elimination of service charges up to and including 5 kva transformer capacity per farm customer.
3. More favorable and more uniform farm line construction policies.
4. Elimination of multiple meter installations and the use of one meter for light, heat and power.
5. A better understanding between the utilities and agriculture and the problems affecting each of the two industries.
6. A more complete connection of customers; over 90% of all rural customers along existing extensions are now taking service.
7. More adequate farm wiring jobs.
8. Increase uses of electricity for farm power and above all the conversion of the farm house into a farm home where comforts and convenience add their quota to life.

A Complete Farm Service Department

To make rural electrification plans effective—to develop the load—to assist the farmer in efficient and more extensive utilization of the service—to focus and promote cooperative activities among the varied interests concerned—and to provide permanent working contacts between company and customer—the Company has organized and staffed a complete Farm Service Department.

This work is directed by the Farm Service Supervisor in the Company's general offices at Jackson. Fourteen Farm Service Engineers work from Division offices.

Division Activities

The execution of the Rural Electrification program in the divisions is conducted under separate departments. The promotion and construction of new rural extensions are under the supervision of the Distribution Engineering and Right of Way Departments. The sale of company merchandise is limited to domestic equipment and is under the supervision of the Merchandising Department. The sale of domestic and farm equipment by local dealers is fostered by the Cooperative Merchandising and Farm Service Departments.

Building load on rural lines is not primarily a merchandising job but a job of education. The Rural Service Engineers devote their entire time to educating rural customers, especially farmers, to the many advantages and uses of electric service, and in cooperating with various agencies in the furtherance of a load building program. Most of these men are recent college graduates; others have been with the company some time and have worked as rural engineers or have been transferred from other departments. These men have been carefully selected in accordance with the following qualifications:

Qualifications of an Agricultural Engineer

1. Honesty.
2. Personality.
3. Faith in the Program.
4. Training.

1. The attributes of honesty need no comments.

2. Personality: In addition to good appearance, neatness, etc., there must be the ability to establish confidence, as the same customers will be contacted numerous times. A phlegmatic disposition is essential, as a farmer is seldom in a hurry and delights in reminiscing on past experiences and expressing his ideas. Incidentally, this is the trait to cultivate even though it requires unlimited patience at times.

3. Faith in the Program: To appreciate the value of the service that is being rendered and to get a "kick" out of accomplishment that is over and above the salary value.

4. Training: An agricultural background that permits a rapid analysis of present operating conditions and proper readjustment through electric operation.

The outline of Rural Electrification Work is:

1. To learn through census reports, the County Agricultural Agents an dother sources of information the type of agriculture of the area, the nature of the market, the farming characteristics of the people, in short to secure a good vision of the whole agricultural picture. The Divisions can then be zoned into respective activities for better correlation of the work.

2. To establish a schedule of routine farm visits to minimize travel and insure maximum number of visits.

3. To discuss with farmers individually their operating problems and to be an adviser on all phases of agriculture from crop rotation to remodeling buildings, always keeping in mind the part electricity will play.

   a. To stress the advantages of electric operation over other operations.

   b. To furnish information on various equipment, motors and installations.

   c. To build toward a farm management system of progressive electric development.

4. To conduct wiring schools and demonstrations for convenient and adequate wiring.

5. To cooperate with farmers having good installations of different kinds of equipment and to conduct auto tours of "prospects" where the representative equipment is installed.

6. To work with the Smith-Hughes Agricultural Vocational Teachers, The Farm Bureau Junior League, 4-H Clubs, Parent-Teacher Associations and County Agricultural Agents on an educational program of rural electrification.

7. To build a strong dealer cooperative organization among the implement and hardware dealers for the merchandising of farm equipment.

8. To cooperate with the Agricultural Engineering Extension Division of the Michigan State College and arrange through the County Agricultural Agents for meetings and demonstrations to be conducted by the College.

9. To assist in conducting rural electrification schools.

10. To cooperate with County Agents in establishing Demonstration Farms.

The fruition of extension and load development policies is summarized in the figures showing growth of farm line mileage, customers connected and consumption increases, quoted in the first column.

The Company's policies go beyond the building of lines and delivering of current. They are connected with continued enterprise in all fields that will benefit the farmer by increasing electricity's usefulness, enhance its value as a farm "implement," and enrich his home life.

Continuous and aggressive promotional and cooperative activities have been maintained in these directions.

Farm Visits

Through advertisements, company literature, announcements at meetings and by the post-card method, the Company offers free agricultural engineering service on any phase of agriculture to its rural customers. The result has been numerous inquiries on wiring and equipment.

A few months after new customers are connected to service a review is made of the meter read books to learn if the customer is using the amount of energy included in his minimum monthly bill (average $2.50). If the use is below the minimum, a visit is made to the farm and the customer is shown how his use can be increased at little or no additional cost to his service bill. The customers

are grateful for this information and the rural engineer gains in their confidence. This confidence increases to the point that in many instances the customers refuse to purchase new equipment without consulting the rural engineer. Advice is then given on the merits of the operation and how it fits into a progressive plan of using equipment in the more productive operations to support use in the less productive operations. The number of farm visits made during the year was 11,562.

Electric Schools

The fourteen electric schools as conducted during 1937 and those scheduled throughout 1938 are of sufficient educational importance to warrant more than a brief narration. The subject material as presented in the November issue of *C.R.E.A. News* is so well covered that the report is used herewith.

TWO-DAY RURAL ELECTRIFICATION SCHOOLS ARE POPULAR IN MICHIGAN

D. G. EBINGER
Rural Electrification Extension Specialist
College of Agriculture,
East Lansing, Mich.

The extension specialist in rural electrification has passed the pioneering stage of developing a program that will familiarize agriculture with rural electrification information. He is today faced with the problem of keeping pace with a fast moving program.

On July 1, 1937, nearly 75,000 Michigan farms were enjoying the benefits derived from central station electric service. Some of these farms have been using electricity for a number of years; others have just recently received service; and there are also thousands of farms just about to connect to the high line. Each of these groups are asking for answers to their electric problems. Many are interested in wiring, others are concerned with the selection and proper use of fixtures and equipment, and still others desire information on new uses for electric power. To adequately cover all of these details in the conventional one-and-a-half or two-hour extension meeting is practically impossible. To give information to all of these groups the writer has assisted in conducting farm electrification schools throughout the state of Michigan. These schools, covering a period of two days each, are sponsored through the cooperation of various agencies —the country agricultural agent, the utility serving that particular area, the local implement, hardware and electric dealers interested in merchandising farm electric equipment and the Extension Division of the College.

To arrange the program and details for one of these two-day schools requires considerable time and effort on the part of all cooperators. A typical school shapes up about as follows: The county agricultural agent after determining that such a school is necessary selects a suitable location, usually in the heart of the area he is attempting to serve. The next step is to arrange an adequate program which will cover the use of electric energy on the farm and in the farm home in such a way that the rural consumer of electricity can receive the most benefit. To accomplish this end it is necessary that a display of electric equipment adaptable to the farm and farm home be exhibited. It is the agricultural agent's organization that contacts the local dealers who normally serve the area covered by the school and gets them to exhibit electric equipment. The dealer installs this equipment in a space provided him for this purpose. Usually a representative of the exhibiting firm attends his own display for the purpose of answering questions that may pertain to his own particular brand. The selling of goods is not a part of this program. This is strictly an educational activity and one in which the dealer is glad to cooperate.

Household equipment, such as ranges, refrigerators, radios, washing machines, irons, water heaters and small appliances, together with the farm equipment, including pumps, motors, feed grinders, milking machines and cream separators, make up the display. Supplementary exhibits featuring the adaptation of electric power to home-made equipment,

DOING THE JOB FOR THE FARMER
FACTS TALK . . . AND RESULTS COUNT!
Here Are Rural Electrification Facts and Results
Michigan farmers want rural electrification—and they're getting it from the utility companies of the state. Michigan's utilities have set a pace for the nation—and have done it for eight years.
The farmers want rural electrification in a way that's dependable, safe, permanent and economical. Consumers Power Company's program of construction, operation, maintenance and cheap rates, as an example, gives them known values in all respects.
Consider These Facts About Consumers Power Company's Results!
3,683 miles of rural lines were built in 1937. This brought the total to 10,739 miles of rural lines now in public service.
19,613 new rural customers received service for the first time in 1937—bringing the total to approximately 80,000 rural customers.
41,387 of these are farms. This means about half of all the farms in the company's territory are already electrified.
Farms using more electricity—cheaper!
Farm customers enjoy "city rates"—and the more used for home conveniences and farm chores, THE CHEAPER THE PRICE. And they get 24-hour "city service" with it.
1,079 kilowatt-hours was the average used per farm customer in 1937. This is 43% more than they averaged in 1935.
But . . . Farmers bought that at the lowest average price in our history—3.15c per kw-hr. This is 17% BELOW the 1935 price.
Every one of these figures stands for benefits to the farm. Coupled with these figures . . . the Company has an experienced staff on the job to work with farm customers in getting the most help from their new electrical farm-hands. And they will continue on the job.
Just Write or Visit Our Nearest Office
Consumers Power Company

One of the advertisements of Consumer Power directed to Michigan farmers

such as feed mixers, grain elevators, hay hoists, and poultry house lighting and water heating equipment, is furnished by the Agricultural Engineering Department of the College of Agriculture.

Publicity for these schools is provided by the County Agent who sends out news letters and invitations to those people interested in farm electrification. These schools are set up purely for the rural folk. Additional publicity is furnished by the College of Agriculture, this material usually being sent directly to the local newspaper. In some instances, the local publishers have devoted entire sections of their papers to special rural electrification editions.

In presenting the program to the rural people it must be remembered that all stages in the development of farm electrification are represented, thus these two-day schools are broken up into definitely arranged meetings.

On the first day there will be a wiring school for the men. The need for adequate capacity in wire is emphasized; the desirability of properly located power and convenience outlets is stressed; the various wiring methods and materials are discussed. It is emphasized that an expenditure of $150.00 will be required to adequately wire the average Michigan farm. This expenditure represents an investment which merits considerable thought. It is not the intent of this meeting to teach farmers how to wire their own buildings, but it is aimed to point out just what constitutes an adequate farm electric distribution system.

While the men are attending the wiring school, the ladies are attending a school on Home Economics. This is conducted by a home economist furnished by the utility, cooperating with the home demonstration agent, an assistant of the county agricultural agent.

In the evening of the first day there is a discussion of rates and policies concerning farm line extensions. This portion of the program is handled by a representative of the utility. Then there is a home lighting school in which requirements, lamps and fixtures, and the advantages of adequate lighting are discussed. This part of the program again is furnished by the utility. In closing the first day's meeting a sound picture depicting the uses of electricity on the farm is shown.

For the men there is an afternoon session on the second day—an electric motor and farm equipment school. In this meeting the proper type of electric motor adaptable to the farm is discussed. Demonstrations are conducted showing the limitations of certain types of motors. A demonstration of the farm equipment on display is conducted together with a discussion concerning the use and limitation of this equipment, the original investment necessary to procure the equipment, and its operating costs are covered.

The ladies, in the meantime, are attending a cooking and home appliance school. During the evening of the second day there will again be sound pictures and, if the crowd is largely a different one than attended the first evening's meeting, the same film and lighting school will be repeated, otherwise this will be varied.

These schools, fourteen of which have been held in eight months, have been well received, the average attendance being approximately three hundred. These shows have enabled us to present to the rural users of electric energy a detailed program. They have enabled us to point out and prove that electric energy used in quantity will more than add its share of profit to the farm income. These schools have given us an opportunity to show that electricity is no longer a luxury, that it is now a decided necessity, that farmers who have electric service and use this low cost, efficient method of operation have a decided advantage over their competitors who depend on more laborious and more costly methods of producing and processing their products.

The fourteen schools which have been held to date were largely experimental in nature. They were used as a means of testing a new educational method. The county agricultural agents who assisted in setting up and conducting these schools were well pleased with the results of these meetings and have requested that additional schools be conducted in their counties during the next year. Requests have also come from county agricultural agents who did not participate in the shows of the past but have heard of the success of the venture. The two-day farm electrification school is now included as one of our extension projects.

Wiring Schools

In addition to the Farm Electrification Schools, the Rural Service Engineers conducted one hundred and two wiring schools in communities about to receive service. The general procedure is to have a farmer invite his neighbors to his farm. The engineer then lays out an adequate wiring job for that farm on a large chart giving the reason for the number and location of switches, convenience outlets, circuits and size of wire. At the same time he answers questions the farmers present relative to their wiring problems. An endeavor is made to get local contractors to attend these meetings; the result has proven satisfactory. . .

Farm Bureau and State Grange Meetings

The Farm Bureau and State Grange meetings conducted by the Rural Service Engineers were largely in the form of local meetings and the discussion of local problems, supplemented by a showing of the sound film "Forward to the Farm."

In addition to these meetings, regular meetings of these two major farm organizations, have been attended by the Farm Service Supervisor, at which various phases of the rural electrification program are candidly discussed, suggestions are exchanged and plans determined to insure continuous development on a sound economic basis. It is the policy of the company to cooperate in its agricultural program with these organizations so vitally interested in the welfare of Michigan agriculture.

Junior Farm Bureau Meetings

Members of the Junior Farm Bureau generally termed the F.F.A. Club (Future Farmers of America Club) consist of young men and women who have graduated from high school and are too old to participate in 4-H Club work. Quite frequently college graduates belong to these clubs, organized throughout the State. The objective of the clubs is to study ways and means of improving agriculture from an industrial and community viewpoint. The Farm Bureau and the Company cooperate in an educational program of this phase of agricultural development.

Rural Parent-Teacher Meetings

The rural Parent-Teachers meetings were built around the presentation of sound film and discussions of electric uses. When these meetings are conducted in schools having electric ranges, the Home Economist of the Company or some of the school students demonstrate range operation.

The Home Lighting Advisers and the Rural Service Engineers cooperate very closely in the presentation of their programs before rural group meetings. The combination is ideal in that it presents factual information on good lighting and emphasizes that in addition to good lighting there are many other ways to use energy to advantage.

Smith-Hughes Projects

The vocational agricultural teachers of the high schools of Michigan, as in other states, are generally known as Smith-Hughes teachers.

In cooperation with Smith-Hughes teachers, the Rural Service Engineers discuss the problems of rural electrification in the classroom and loan various equipment for laboratory purposes. A simple brake test showing the operating characteristics of the split phase vs. repulsion induction types of motor, the resultant effects of an overloaded circuit, operation tests of small feed grinders, soil heating cable and similar uses are popular laboratory exercises.

In addition to classroom work, vocational agricultural students are required to conduct under supervision a practical agricultural project during the summer vacation period. Eight such projects, including heating hotbeds with soil heating cable, keeping records on milking machine and silo-filling operations and the

construction of a grain elevator are some of the rural electrification projects completed this year. Work of this nature stimulates general neighborhood interest.

Demonstration Farms

The demonstration farm method of emphasizing electric use is very effective if established under normal practical working conditions on a farm that is selected as to desirability of location and that is operated by a farmer who is a good cooperator and whose judgment is respected in the community.

The equipment used should provide a balance between house and farm operation and be of a nature not to verge on the spectacular.

A few representative uses on different farms is much more effective than too many uses on one farm. A farm with too much equipment gives the impression that farm electrification is dependent upon excessive investments.

Demonstration farms have been established in four representative counties. The number of demonstration farms is limited to two per county so as not to impose too heavily on the cooperating dealers supplying equipment.

Dealer Interest

Interesting local hardware and implement dealers to stock and actively push the sale of electrically operated equipment is a most important part of the load building plan of the Company. The Company does not sell electric equipment other than domestic equipment. The rural engineers establish routine visits to the dealers. They supply them with information as to the location of new extensions, furnish data as to prospective customers and on the trends in agriculture, and endeavor in every way possible to make the dealer a definite and vital part of the program. Farm equipment, bearing the dealer's name and operating data, are also displayed in Company stores.

In cooperation with the Committee on the Relation of Electricity to Agriculture, the Company is conducting an analysis on farms, representative of the widely diversified agriculture of the area served.

Each of the fourteen Rural Service Engineers undertook a project in his respective division. The purpose is twofold in nature: To determine factual information for the National Committee and permit each man to more closely study problems related to his work.

This project is also being enthusiastically accepted by Smith-Hughes teachers and students taking Farm Management work. The information derived from projects of this nature, as conducted by high school students, is useful in developing students' interest and increasing their knowledge of electric uses.

The story of Rural Electrification by Consumers Power Company is a story of cooperation.

From the beginning, the Company has cooperated with the Michigan State College, the Farm Bureau and the State Grange in determining a program best adapted to the State. The cooperation with the College extended to the Agricultural Experiment Station in the development of new uses of electricity; to the engineering experimentation station in the establishment of the Michigan "Test Line" and to the Extension Division and County Agricultural Agents in taking the message of rural electrification to the farmer. Further cooperation was extended to the manufacturer, the dealer, and other utilities and national organizations as the Committee on the Relation of Electricity to Agriculture, the Edison Electric Institute and the American Society of Agricultural Engineers.

This cooperative enterprise has fused the aims of the individual, corporations and other agencies into the common objective of extending service into rural areas and promoting the widespread use of service for the multiplicity of tasks in the home and on the farm.

The facts set forth relating to development activities reveal the tangible and productive character of this cooperation.

Call the roll of agencies with which the Company is cooperating—and the scope of this policy is forcefully demonstrated.

Cooperating Agencies

Agricultural Engineering Extension Dept., Michigan State College.
County Agricultural Agents and County Home Demonstration Agents.
Agricultural Experiment Station, Michigan State College.
Michigan State Farm Bureau.
State Grange.
Smith-Hughes High School Teachers.
Michigan Public Utilities Commission.
Manufacturers of Electric Equipment.
Michigan Retail Hardware Dealers Association.
Local Dealers and Distributors.
State Horticultural Society.
Michigan Dairy Association.
Michigan Electrical Inspectors Association.
Electrical Contractors.
Farm Journals and Newspapers.

Each month a list of the customers that have contracted for service during the previous month is sent to cooperating manufacturing companies, who have established progressive sales methods. Local dealers receive the lists from breakdowns made by the manufacturing companies. It is agreed with the manufacturing companies that such lists shall be used only for the promotion of electric sales. The Electric Departments of Sears, Roebuck & Company and Montgomery, Ward and Company are among those receiving customer lists.

It is the policy of the company to review farm electrification problems with the Electrical Inspectors at their group meetings. Many misunderstandings and differences of opinion have been satisfactorily handled in this manner.

The Rural Service Engineers encourage the attendance of local wiring contractors at all educational meetings. This has been a stimulus to more adequate wiring jobs.

During the year, the Company has cooperated with the Water Systems Council of the Edison Electric Institute in its excellent project of increasing the sale of water systems. Distribution of the booklet "Life in the Country" is included in this work.

Statement to TVA Committee

(*Continued from page* 498)

agree to abide by the valuation which the Securities and Exchange Commission may finally set upon our properties. I don't say this because I want to sell these properties. I am selling them only because they face government subsidized competition and duplication, and the several hundred thousand security holders in the Commonwealth & Southern system will suffer a loss in their investment. In my responsibility to these security holders I ask you, if you are going into this question of value, to follow the proposed method, whereby the value of the properties which are to be sold can be fairly determined.

To my mind, your Committee holds the key—and the only key—to the solution of a controversy that has disturbed the nation's security markets and hampered its economic rehabilitation for more than five years. If you take advantage of this opportunity I firmly believe you will have the support of the American people.

PRIZES AND AWARDS

to be administered by the

EDISON ELECTRIC INSTITUTE

and awarded in 1939

Prizes to Individuals

For Papers on Subjects Relating to the Electric Light and Power Industry

FORBES PRIZE . . . . . *Public Relations*

A cash award of $250 donated by Mr. B. C. Forbes, Editor, Forbes Magazine, for the most meritorious paper dealing with the subject of Public Relations in the Electric Light and Power Industry.

McGRAW PRIZE . . . . . *Engineering*

Cash prizes of $250, $150 and $100 donated by Mr. James H. McGraw, Honorary Chairman, McGraw-Hill Publishing Company, for the three most meritorious papers on any Engineering or Technical subject relating to the Electric Light and Power Industry.

RULES AND CONDITIONS OF CONTESTS FOR ABOVE PRIZES TO INDIVIDUALS

Any person employed by an electric light and power company is eligible to enter the competition. No person is eligible to win two years in succession the identical prize or lower prize of the same award, but is eligible for a higher prize of that award. Papers must be the original work of the author or authors, prepared exclusively for this competition. Papers may be of any length, and pen-and-ink drawings or photographs suitable for reproduction may be included. Papers should be typewritten on one side only.

The first page of the manuscript must give the following information: the name of the prize for which the paper is submitted, title of paper, name of author, name and address of employing company, title or character of position and home address. One paper may not be submitted for more than one prize.

Papers not receiving awards will, upon request, be returned to contestants after the awards have been announced at the 1939 Convention of the Institute. Prize winning papers will be available for inspection at the general offices of the Institute.

Papers for above prizes must be forwarded, in duplicate, by March 1, 1939

Awards to Individuals

For Accomplishments or Acts as Specified

THE R. B. MARSHALL AWARD . . . . . *Electric Ranges*

A cash award of $500, divided into five equal parts of $100 each for utility representatives who sell, lease or rent during the calendar year 1938 the greatest number of individual domestic electric ranges of a rated capacity of seven kilowatts or more.

The purpose of this award is to promote greater activity and efficiency among utility retail salesmen.

CLAUDE L. MATTHEWS AWARDS . . . . . *For Valor*

For acts of devotion to duty wherein extraordinay courage has been exercised in efforts to maintain important electric service or to restore service in the shortest possible time.

Three cash awards each of $150 are offered for the calendar year 1938 by Mr. Claude L. Matthews, Vice President, W. N. Matthews Corporation, to the individuals selected on the basis of evidence submitted, as being most entitled to the awards. A citation and an appropriate button or pin will accompany each cash award.

Recommendation for the award must be submitted by the President or acting executive head of the company in which the person recommended is or was employed. All recommendations for the year 1938 must be forwarded to the secretary of the Edison Electric Institute not later than *March 1, 1939*. It is urged that a recommendation for the valor award be submitted as soon as convenient after the occurrence of the act of valor.

Statements substantiating entries for above awards must be forwarded, in duplicate, by March 1, 1939

Complete details concerning the two above awards should be secured from the Secretary, Edison Electric Institute, 420 Lexington Ave., New York, N. Y.

Awards to Companies and Individuals

For Accomplishments in Specified Activities

CHARLES A. COFFIN AWARD

Sponsored by the General Electric Company

A Gold Medal, known as the Charles A. Coffin Medal will be awarded for the year 1938 to the public utility operating company, within the United States, which has achieved the greatest advancement in its operations and physical plant, thereby making a distinguished contribution to the development of electric light and power for the convenience of the public and the benefit of the industry. The company awarded the medal will also receive $1,000 for its employes' benefit or similar fund.

AUGUSTUS D. CURTIS AWARD

Lighting of Buildings

A certificate donated by Messrs. Darwin Curtis and Kenneth Curtis, of Curtis Lighting, Incorporated, in memory of Augustus D. Curtis, to the public utility operating company within the United States which, during the twelve month period ending March 1, 1939, has shown the greatest contribution to the advancement of Artificial Illumination of interiors or exteriors of Commercial and Public Buildings, and a cash prize of $300 to the individual or individuals in that company responsible for the achievement. A second prize of $200 and a third prize of $100 to the individual or individuals responsible for the achievement of the companies adjudged second and third in the contest.

GEORGE A. HUGHES AWARD

Domestic Electric Cookery Load

A trophy donated by Mr. George A. Hughes, President, Edison General Electric Appliance Company, Inc., to the public utility operating company within the United States which, during the year 1938, has shown the greatest contribution to the development of the Domestic Electric Cookery Load through promotion, or selling, or both, and cash prizes totaling $1,000 to the individuals responsible for the achievement.

THOMAS W. MARTIN AWARD

Rural Electrification

A bronze plaque donated by Mr. Thomas W. Martin, President, Alabama Power Company, to the public utility operating company within the United States which, during the year 1938, has shown the greatest contribution to the advancement of Rural Electrification-Agricultural advancement within the company's territory due to uses of electricity, development of rural load, cooperation with other agencies, extension of rural lines, organization and plan for conducting rural electric development.

Presentations of accomplishments must be forwarded by April 1, 1939

IMPORTANT—Complete details for the Charles A. Coffin Award, the Augustus D. Curtis Award, the George A. Hughes Award, and the Thomas W. Martin Award *should be secured from the Secretary, Edison Electric Institute, 420 Lexington Avenue, New York, N. Y. Elaborate and costly exhibits are unnecessary. The merit of the enterprise presented in papers or exhibits will be the prime factor in determining awards, without regard to the size of competing companies.*

Papers and Exhibits for 1939 prizes should be addressed to the Secretary, Edison Electric Institute, 420 Lexington Avenue, New York, N. Y. Winners will be announced and prizes awarded at the 1939 Convention of the Edison Electric Institute

PRIZE AWARDS COMMITTEE: Charles W. Kellogg, James E. Davidson, H. P. Liversidge, *Chairman*, Lewis B. Beatty, *Secretary*

American Street and Highway Lighting Practice

By L. A. S. Wood

Chief Lighting Engineer, Westinghouse Electric and Manufacturing Company

A paper presented before the Vienna Sectional Meeting of the World Power Conference at Vienna, August 15 to September 2, 1938

PART I—STREET LIGHTING PRACTICE

STREET LIGHTING in America during the past quarter of a century has followed somewhat different lines to those common in Europe in that with the introduction of the gas filled incandescent lamp (replacing the Arc Lamp as the major street illuminant), American merchants began to appreciate the value of street lighting in attracting business.

As a result, "Whiteways," rivaling daylight, were installed in business streets throughout the country. These Whiteways were generally financed by contributions from local merchants or by assessment of abutting property owners. Visibility was of a high order and accidents infrequent. Areas outside business districts, however, were neglected to such an extent that the level of illumination on these streets is far below the requirements for safety.

Dangerous City Streets

The Whiteway Era in the United States ended with the advent of the depression and since then an entirely new conception of street lighting has grown up which is leading to a more generous use of electrical energy and a greater degree of traffic safety.

A recent survey of 47 American cities with a total population of 19,000,000 showed that the most dangerous streets are the main traffic thoroughfares which, although representing barely 10 per cent of the total street mileage, accounted for 77 per cent of the total traffic fatalities, of which 69 per cent occurred at night. The residential streets accounted for most of the other fatalities.

Last year (1937) 39,700 persons were killed by automobiles in the United States and of these, nearly 25,000 lost their lives during the hours of darkness as compared with 15,000 killed during daylight.

The curve of total traffic fatalities follows closely the curve of motor vehicle registration and many persons believe that the rising toll of death is the logical and inevitable result of increased traffic. Further analysis, however, shows that while the annual trend of daytime fatalities is downward, the night fatality rate is rising rapidly.

Relation of Visibility with Speed

The major cause of the large increase in night fatalities over daytime experience is lack of visibility at night coupled with no material reduction in night driving speed. Speed and visibility are complementary factors in traffic safety, and a substantial reduction in speed at night, or an increase in night visibility would undoubtedly be accompanied by a reduction in traffic accidents.

Speed studies show that at 20 miles per hour, a car on a dry road with brakes in average condition cannot be brought to a stop in less than 52 feet. At 40 miles per hour, the stopping distance is 164 feet, while at 60 miles per hour, it is 330 feet. In wet weather, when visibility at night, under existing lighting conditions is reduced, stopping distance is nearly doubled. Statistics also show that automobile fatalities increase with speed. At 20 miles per hour, one accident in 61 is fatal, but at 60 miles per hour, one in 11 is fatal.

This suggests a new approach to the problem of street lighting, namely, "Safety Through Adequate Visibility," or in other words, "Matching Visibility with Speed."

Method of Discernment

It is now recognized that objects are seen more readily by contrast than by direct illumination and street lighting systems to be effective, should provide the brightest possible road surface against which objects in the street may be seen as silhouettes in contrast with the pavement beyond. Street lighting systems should be so designed as to reproduce at night, visibility conditions associated with daylight visibility. Recent experience in many American cities has proved conclusively that night visibility conditions equal to daylight visibility will tend to equalize the day and night traffic fatality experience.

Following a practice established in the days of the horsedrawn vehicle, automobiles are equipped with headlamps for night driving and at the speeds prevailing at that time, headlamps were undoubtedly effective.

The visibility distance of the automobile headlamp twenty years ago was in the order of 225 feet under the most advantageous road surface and weather conditions. In wet weather, or on dark roads, the visibility distance is materially reduced. In the past 20 years, however, cars in the United States have increased in number 600 per cent, in mileage per car 125 per cent, and in speed 100 per cent, but while many improvements have been and still are being made in headlamp design, their visibility distance has remained substantially the same.

Social experience has proved the impracticability of reducing speed to automobile headlamp visibility distance and, because of legislative limitations of beam-candle-power, there is little hope of increasing beam candle-power to modern speeds. The remaining alternative is to increase driver visibility distance to modern speeds.

This can be accomplished either by flooding the streets at night with light as in Whiteways, where discernment by direct illumination is possible, or by the less expensive and more effective method of rendering the surface of the road bright so that objects may be discerned as silhouettes against the bright background of the pavement beyond.

In the United States, the pedestrian represents the largest group of automobile victims and because the pedestrian, when a collision is imminent, is generally too confused or too close to danger to save himself, the burden of avoiding an accident rests in greater degree on the automobile driver than on the pedestrian. Street lighting systems should, therefore, be designed to provide the highest degree of visibility for the automobile driver.

New Technique

According to the Code of Highway Lighting, published by the Illuminating

Engineering Society (U. S. A.), "In order that the pavement shall appear bright (to the automobile driver), it is important that much of the direct reflection of light from it shall be in the direction of the motorist." The code further states that "Problems of spacing, mounting height, and equipment are interwoven and mutually dependent and that a large proportion of the light which is provided should be delivered on the roadway . . . this should be accomplished with the most uniform practical distribution of brightness and with the least possible glare."

Based on this simple statement, an entirely new type of equipment has been developed for street lighting, together with a new technique which has revolutionized American street lighting practice.

New Luminaires

The new luminaire consists essentially of an extended hemispherical aluminum reflector finished by the Alzak process, equipped with a "deformed" pear shaped globe. The light source is located within the reflector completely shielded from the eye of the observer. The distribution of this unit is symmetrical and it is installed at a spacing of approximately three times the mounting height.

A symmetric distribution, suitable for a spacing of 5 times the mounting height, is obtained by locating supplementary reflectors within the globe on the house side rigidly attached to the main reflector. These supplementary reflectors direct the light flux up and down the street at grazing angles to produce surface brightness for the automobile driver and at the same time shield the buildings from undesirable light emission.

For locations where wider spacings are desirable, lateral distribution is attained by substituting a specially designed one-piece Holophane refractor for the pear shaped globe. In this combination, the prisms are so designed as to reduce the surface brightness of the refractor to a minimum. A spacing of eight times the mounting height is permissible with this luminaire.

The new luminaires are made in two sizes, the smaller to accommodate lamps up to 10,000 lumens (1000 candlepower) series or 500 watts multiple and the larger for lamps up to 15,000 lumens (1500 candle-power) series or 750 watts multiple.

Road Surface Conditions

Road surface conditions are vital factors in the application of the new technique. It is a simple problem to design a lighting system which will produce uniform brightness on a light dry (diffuse) road because the light from the lamps located adjacent to the roadway, on striking the road surface, will be diffused in all directions and the surface will appear bright when viewed from any or all directions.

To produce surface brightness for the automobile driver on a dark or wet road surface, requires careful study and involves refinements in lamp placement and luminaire design. Most roads, however, possess an element of specularity and a lighting system which is effective on a wet road surface should provide adequate visibility on a dry dark surface. In addition, it will produce effective visibility on a light dry road.

Location of Luminaires

In order that the light reflected from the road surface shall be directed toward the driver, it is necessary that the new luminaires be mounted out over the roadway and suitable lighting standards have been developed which locate them approximately 4 feet over the roadway and from 20 to 25 feet above its surface in accordance with the spacing-mounting height ratio for which the luminaires are designed.

Many installations of the new equipment have been made in the United States in the past three years, but the most significant results have been obtained in Detroit, Michigan, where accurate accident records have been kept before and after modernization.

Proof of Effectiveness

In Detroit it was found that most of the fatalities were occurring on 31 miles of main thoroughfares where the ratio of night to day fatalities was in the order of 7 to 1. Supported by a $3,000,000 appropriation, Mr. L. J. Schrenk, General Superintendent of Detroit's Lighting Commission, started in the latter part of 1936 to modernize the lighting on these thoroughfares. In 1936, the night fatalities on these thoroughfares were 35 and the day fatalities on these thoroughfares 5. In the first 10 months of 1937, under the new lighting system, the night fatalities were reduced to 6 and the day fatalities remained at 5, or a ratio of 1.2 to 1.

PART II—HIGHWAY LIGHTING PRACTICE

Highways are defined in the Code of Highway Lighting of the Illuminating Engineering Society (U.S.A.) as "Traffic ways in which there are not more than four intersections per mile and on which there is little pedestrian traffic."

Highway lighting includes the illumination of straight highways, curves, hills, underpasses, bridges, traffic circles and grade crossings, all of which require special study and treatment. It involves the illumination of long stretches of roadway, the surface characteristics of which may vary constantly in color, texture, and reflection factor. In brief, it resolves itself into a problem of designing an overall lighting system which will be equally effective on dark or light surfaces and in dry or wet weather with special treatments for the other factors enumerated.

The same methods of discernment by silhouette as are employed under the new technique on main thoroughfares and in residential areas are employed in highway lighting and the systems are designed to provide maximum visibility for the automobile driver. Here the necessity of matching visibility with speed plays an even more important part than on urban streets where traffic is likely to be more congested.

Highway Authorities

Highways in the United States are controlled by State, Township and County authorities, assisted sometimes by financial aid from the Federal Government. The major source of revenue for the State Highway Departments is derived from gasoline taxation originally authorized for the construction and maintenance of highways. Several States have enabling acts which permit the use of gasoline tax funds for highway lighting and other States are seeking such legislation.

Progress

In the past several years, a part of gasoline tax funds have been diverted to other than highway purposes and because of the fear that highway lighting might involve further diversion of these revenues from road construction and road maintenance, some interests connected with the manufacture and operation of automobiles and with road construction and maintenance materials have opposed highway lighting. Largely because of this opposition and also because of lack of appreciation on the part of the public of the value of highway lighting as a safety measure, highway lighting in the United States has not progressed as extensively as in some of the countries of Europe.

There are, however, in the United

States, many short stretches of highway lighting which have demonstrated its value, the largest of which are 9½ miles of sodium lighting on the San Francisco Bay Bridge and 17½ miles near Schenectady, New York.

Highway Luminaires

Two schools of thought have developed in the United States; one advocates the use of the larger light sources mounted in luminaires with unshielded light sources designed for a spacing-mounting height ratio of 8 to 1 with comparatively high mounting and wide spacing and, another school advocating the use of smaller light sources mounted in luminaires with shielded light sources designed for a spacing-mounting height ratio of approximately 5 to 1 with comparatively low mounting heights and shorter spacing.

For the unshielded type of luminaire and wide spacing, the sodium vapor lamp appears to be the most suitable light source for highway lighting and two types of luminaires have been developed for this application.

Type No. 1 is designed for use with the 6,000 lumen or 10,000 lumen sodium lamps mounted vertically in a simple optical system designed for a spacing-mounting height ratio of 8 to 1.

Type No. 2 is designed for use with the 10,000 lumen sodium vapor lamp mounted in a horizontal position. In both these luminaires the light source is unshielded and no glassware is used other than the flask enclosing the lamp.

Both luminaires are designed for side mounting approximately 5 to 8 feet out over the roadway and may be operated on a straight series 6.6 ampere circuit or from the secondary side of isolating transformers.

Type No. 3 is a truncated frustrum reflector with no glassware for use with the 4,000 or 6,000 lumen bi-post incandescent lamp and in which the light source is shielded from the eye of the observer. This is designed for a spacing-mounting height ratio of 5 to 1 and for side mounting approximately 5 to 8 feet out over the roadway.

Type No. 4 is designed for use with the 4,000 or 6,000 lumen bi-post incandescent lamp or with the 300 or 500-watt multiple lamps. The luminaire consists of an inverted hemispherical reflector to which is attached a two-piece hemispherical Holophane refractor to control the light flux. It is designed for a spacing-mounting height ratio of 5 to 1 which can be increased by lowering the light center to provide 6 to 1, 7 to 1, or 8 to 1 ratios, thus enabling the unit to be used at varying spacings on curves or hill tops.

Types 3 and 4 may be operated in straight series or from the secondary side of isolating transformers.

Mercury vapor lamps are also used for highway lighting and may be applied to advantage at dangerous intersections to differentiate between the highway and the dangerous locations.

It is believed that the next few years will see a large increase in adequately lighted highways in the United States where visibility will be matched with speed.

Summary

The highway lighting system should be effective on dark or light road surfaces and in wet or dry weather. It should be designed to produce maximum visibility for the automobile driver reproducing at night as far as possible visibility conditions equivalent to daylight visibility. Such systems can be provided at reasonable cost by the following prescription:

1. Luminaires should be designed with a light distribution such that light from distant lamps in front of a car striking the road surface some distance ahead of the car will be reflected at such an angle that the surface brightness thus produced will be visible to the driver of a modern automobile.
2. Luminaires should be mounted and spaced in accordance with the spacing-mounting height ratios for which they are designed.
3. Luminaires on straight stretches of highway should be mounted out over the road not less than 5 feet and preferably further from the curb.
4. Luminaires on crests of hills should be set at closer spacings. They should be mounted on the outside of curves and at closer spacings than those on straight stretches.
5. High mounting with wide spacing is generally more economical than closer spacing. Furthermore, high mounting tends to mitigate glare.

PART III—GENERAL

Methods of Operation

Unlike the practice in Europe where arc lamps are operated in multiple or on constant potential series circuits with substitutional resistances or choke coils, arc lamps in America were, with few exceptions, operated on circuits in which the current was maintained at constant level by means of regulating transformers. The characteristics of the enclosed carbon arc lamp which was in general use at the time of the introduction of the gas filled incandescent lamp (1913), were such that they operated at either 6.6 or 7.5 amperes and in this way series circuits of these current densities became standard throughout the country. In the changeover from arc to incandescent lamps, gas filled lamps of these ratings were substituted for the arcs on existing circuits although it was recognized at the time that these ratings were not the ideal. With the demand for higher standards of illumination and larger lamps, higher lamp ratings (15 and 20 amperes) were required and these were operated on existing circuits through single winding (auto) transformers or from the secondary side of two-winding (isolating) transformers. A number of installations are now being operated on straight 20 ampere series circuits; this means lower circuit voltage for a given number of lamps with a consequent reduction in cable insulation and more efficient use of the conductor.

With the increasing use of the protective network system of distribution a large number of street lighting systems are now operated in multiple on the networks, controlled individually or in groups by time switches, remote electrical control through pilot wires and relays or by super-imposed high frequency currents on the network which control the lamps individually or in groups through condenser relays.

Long electrical circuits such as are necessary with highway lighting, and the desirability of keeping line losses within reasonable limits without involving excessive line investment, definitely established the series circuit as the type to be employed in highway lighting. Both the series sodium and the series bi-post incandescent lamps operate at 6.6 amperes and thus a 6.6 ampere series circuit is general practice for this application.

Planned Lighting

Hitherto the burden of promoting street and highway lighting in the United States has fallen almost exclusively on the equipment manufacturers although there is evidence of increased activity on the part of Central Station interests in developing improved street lighting systems. Most of the present street lighting systems have developed on a more or less haphazard manner with little regard for standardization of equipment or traffic conditions. Today,

however, there is a marked tendency toward including street lighting with city zoning plans under which the streets and alleys of the entire city are surveyed and the lighting requirements are established in accordance with the accident and fatality records of each locality. A coordinated street lighting plan for the entire city is thus developed which may be put into effect in any desired locality as and when financial and other conditions justify it.

Financing

The provision of effective street lighting for protection is accepted by municipal authorities as a duty and funds for this purpose, more or less adequate, are provided in the annual appropriations for street lighting service. Such systems, except where municipal light plants are available, are installed, operated and maintained by the Central Stations under contract with the local authority, at service rates controlled by public commissions.

When highway lighting becomes general in the United States, it is assumed that the service will be financed largely out of gasoline tax revenues.

Cost

The annual cost of street lighting in the United States is estimated at $1.20 per capita and little more than three cents in the tax dollar is appropriated for this service. A small increase in this expenditure would bring large returns in the elimination of losses incurred through automobile accidents and fatalities which are conservatively estimated at one and one-half billion dollars annually.

It is estimated that an adequate highway lighting system would cost in the neighborhood of $4,000 per mile to install. This represents about 5 per cent of the cost of building the average highway. The operation and maintenance of such a system without fixed charges on the investment would cost approximately $1,750 per mile per year.

Conclusion

In conclusion, it should be noted that the Codes of Street and Highway Lighting, published by the Illuminating Engineering Society (U.S.A.) have had a marked influence on American lighting practice and have resulted in the installation of many systems which have proved effective in reducting night time traffic accidents and fatalities.

The TVA "Yardstick"

(*Continued from page 467*)

supervision of that body as to the cost of both original construction and subsequent operation. Vast stores of accurate detailed information are available in the files of the Commission as to the exact cost to privately-owned companies of hydroelectric power under all sorts of conditions, many of them exactly comparable with the TVA plants built or proposed on the Tennessee River. The TVA construction and operation can add nothing new to this already existing store of information. The TVA, by the omission from its accounts of the fixed charges which private companies have to bear, obscures rather than illuminates a subject on which tons of official data were already available in the files of the Federal Power Commission.

The utilities in the Southeast in the 20's developed the most economical water power sites. The experience of the licensees under the Federal Power Commission shows investment costs far below those shown by the TVA. The Tennessee River developments would have been made by private companies long ago if they had been economical power developments.

The Retail Yardstick

All that has been said heretofore has applied to the cost of manufacture of power by TVA and hence the corresponding wholesale rates. The TVA, with respect to the communities to which it has sold power wholesale, has also fixed the maximum rates which such communities could charge for retail sales. Such rates are far below what private companies require to pay their costs.

The claim has been made by TVA that the low retail rates it has fixed for its customers produce such large use as to make the low rates remunerative. This claim is best refuted by a comparison between one of the first of the TVA towns (Tupelo, Miss.) and the operations of the Mesilla Valley Electric Company in Las Cruces, New Mexico, a company in the group which I represent. This comparison is shown in Table II.

Tupelo and Las Cruces Compared

It will be observed from the figures that the two situations are quite similar as to energy sales, peak load and load factor. In spite of the much lower rates charged by Tupelo, the energy consumption per residence is actually higher in Las Cruces than in Tupelo; and, while the per cent saturation of refrigerators is larger in Tupelo than in Las Cruces, the reverse is true as to electric ranges (wherein Las Cruces shows over twice the saturation of Tupelo) and electric water heaters (wherein Las Cruces has about four times as great saturation as Tupelo). These last two devices use much more energy than refrigerators. This should dispose of the claim that TVA rates are necessary to produce high consumption of energy.

Comparison of Operating Expenses

Each company purchases its entire energy supply; yet, in spite of Las Cruces buying fuel-produced, unsubsidized energy, and Tupelo buying heavily subsidized hydro energy, the difference in power cost per kwhr is but 44%, or 0.23 cents. The big differences come in other operating expenses, where Las Cruces, with the most careful economy, is 3 1/3 times as high as reported by Tupelo, and in taxes and depreciation 2¼ times as high. The former difference is due to the things done for Tupelo by TVA and the latter to failure to include items the private company must pay.

The same subsidy appears in the Tupelo plant investment, which is less than a third of the national average investment per kilowatt for distribution systems only. The difference was obviously furnished by TVA or by a depreciated purchase price produced by its competition.

NEW E.E.I. PUBLICATIONS

CONDUCTOR SAGS AND TENSIONS FOR RURAL LINES

E.E.I. Pub. F-9. A report of the Transmission and Distribution Committee, Edison Electric Institute, 82 pages. Price 40c. to members and their employees; $1.00 to nonmembers in the U.S.A.; $1.10 to foreign countries.

THIS report presents in the form of charts and explanatory notes, a condensed summary of data on line conductors commonly used for overhead lines in rural and semi-urban areas. These data are particularly intended for use in connection with the design of rural lines and the determination of stringing and final sags to obtain proper clearances to ground, track rails and conductors of other circuits crossed over.

The data on copper and Copperweld-Copper conductors contained in the report were supplied by the Copper Wire Engineering Association, Washington, D. C., and the data on Aluminum Cable Steel Reinforced were obtained from the Aluminum Company of America, Pittsburgh, Pennsylvania.

Considerations Involved in Making System Investments for Improved Service Reliability

By S. M. Dean
The Detroit Edison Company

Presented at Joint Meeting of the Electrical Equipment Committee and the Transmission and Distribution Committee, E. E. I., Old Point Comfort, Va., Oct. 11, 1938

ONE of the really difficult problems faced by those responsible for planning of electric supply systems is that of deciding how far they are justified in increasing the investment in their properties to improve service reliability. While this problem is not at all new in the industry, it has nevertheless taken on greatly increased significance in the past few years. The extension of electric service into the thinly settled rural districts has required that an acceptable degree of reliability be had at a minimum of cost. This increase of extent and exposure of lines has been simultaneous with the increased dependence on the part of the user upon his electric service. The advent of electrical appliances, such as ranges, water heaters, water pumps, oil burners, and the general use of electric power in industry has long since spread the burden of greater dependence from the few hours of darkness in which the lighting load was highly important to eighteen out of the twenty-four hours.

Concurrent with this increase in dependence upon electric service have been continually decreasing rates, and also increased demands on the part of public agencies for the placing of lines underground which greatly increase the cost of distribution. The result of these two conflicting tendencies has been decreasing income per unit of system investment which has made this problem of reliability extremely important and increasingly difficult of solution. Furthermore, the reliability problem can rarely be considered by itself. It is invariably mixed with such considerations as safety, appearance of lines on streets, difficulties in securing rights of way for lines, and also the increasing difficulty and cost of maintaining trained and adequate construction and maintenance forces.

All of this amounts to saying, that there is no ready and easy answer to this problem of investment for increased reliability, and the question therefore becomes—what is the practical and convincing approach to this situation?

Three Aspects

In general, there are three broad aspects of this reliability question.

The first is to know thoroughly the present quality of one's service and just who is harmed by the present outages, and how much. With such a background of system performance it is not difficult to determine where in general the greater hazards lie.

The second aspect is a knowledge of the methods at hand to improve service in the many situations which arise, as well as the cost of these remedies. It is highly important that these methods of improved reliability be studied out in advance and their effectiveness and cost clearly defined. It is very easy to lapse into vague generalizations which may not, in fact, be anything like as effective as they first appear.

The third and most important is the exercise of judgment as to where and when, all things considered, expenditures should be made for increased reliability and how far to go with them. In theory, the criterion is that of customers' complaints and what increased price he is willing to pay for more reliability. In practice, it is very difficult to determine how many complaints concerning a given kind of trouble are sufficient to justify added expenditure to correct it, and there is no way of asking the customer how much he is willing to pay for improved reliability. Furthermore, the individual complaint or complainant very often assumes commercial importance far beyond his importance numerically. Often improvements must be made in such situations which, from the point of view of the system as a whole, may not seem justified.

A Background of System Performance Highly Necessary

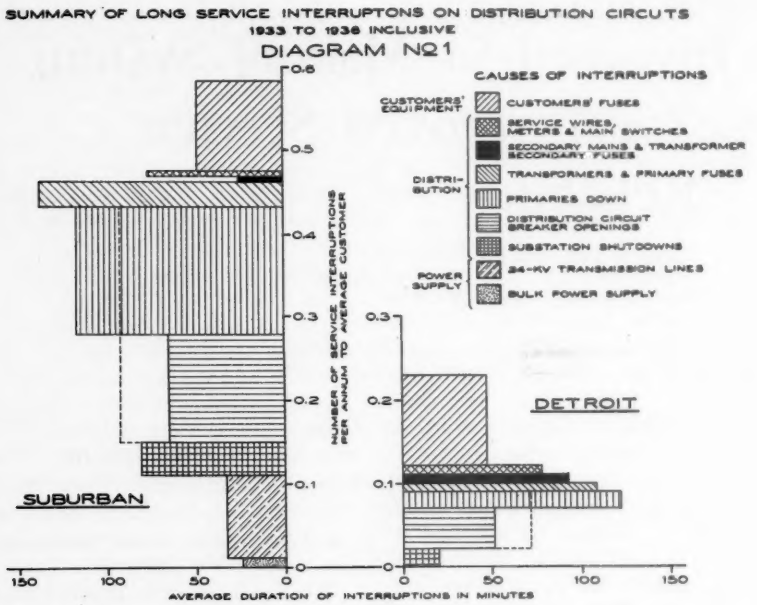
When a large storm sweeps over an electric system or when the failure of some major section of a system causes some long outage, it attracts a great deal of attention and often results in pressure to make changes in the system, the effectiveness of which may not be altogether understood. It is very salutary under those conditions to know accurately just who has actually been hurt and how much. Viewed against the background of several years' performance of the system, any incident tends to take on more nearly its true proportion than when considered by itself. Hence, the need for a broad general view of the quality of service being considered.

Diagram No. 1 shows a study which was made on The Detroit Edison Company's system to show, on the average, the incidence of interruption in the case of residential and commercial customers. The Diagram shows the number of long service interruptions per year and the average duration of these by causes, including the customer's service entrance fuses and branch circuit fuses.* The customers have been divided geographically into two groups—those in the suburban territory where overhead 24-kv transmission is largely used and where distribution transformers are operated radially; and those in the city where underground 24-kv transmission is largely used and where ringed primaries and secondary banking of distribution transformers are employed. Distribution lines are, of course, largely overhead in both areas.

A perusal of this Diagram will show a number of very pertinent facts:

1. The average suburban customer suffers

* By long service interruptions are meant those in which the service is not restored by the reclosing of a circuit breaker.



two and a half times as many long interruptions as does the average city customer.

2. The customer's own troubles are responsible for a surprising amount of his long interruptions—in the case of the city customer, some 40 per cent.

3. Primary circuit troubles are by far the largest cause of interruption over which the power company has control and suburban customers have four times as many such outages as do city customers. While increased exposure (largely trees), accounts for some of this difference, a great deal of it is due to the impracticability of primary rings and therefore of secondary banking of distribution transformers in much of the suburban territory.

4. It also indicates that, while troubles on the suburban overhead 24-kv transmission lines are important, they are not of the first order in the average case.

5. Note particularly the almost complete absence of interruptions chargeable to bulk power sources. That suggests that we may have been doing too much of the "heavy worrying" at the bulk power end.

The value of such an analysis as this lies in the fact that it warns against the general use of remedies which may be ineffectual in reducing outages as compared to other remedies. *It by no means indicates that some of the causes of outage, which on the average appear relatively insignificant, may not be of great importance in specific situations.* Care must be exercised to avoid being misled by generalities.

While Diagram No. 1 is valuable generally, it was recognized that, particularly in the suburban territory, the actual service conditions may vary widely from the average. Our least reliable service is that given the outlying rural territory by small substations tapped through fuses off the 24-kv overhead transmission lines, and which, therefore, go down when the transmission line fails. These substations also have only a single bank of transformers. Also, the distribution exposure is greatest in these areas because of greater length of line per circuit but it is fairly uniform in character. Accordingly, a similar study was made covering the twenty-nine substations of this class. Diagram No. 2 shows the results.

1. The average customer in this class of area suffers nearly twice as many long outages per year as does the average suburban customer but the durations are about the same.

2. Again, primary circuits are the single greatest cause of outage, and again he suffers nearly twice as many outages as the average suburban customer.

3. Outage due to 24-kv transmission lines becomes some four times as great as for the average customer. However, further analysis of this item shows that, whereas, some 60 per cent of the outages occur in the daytime, less than one-fifth of them occur during the evening lighting period, and since these areas usually have little, if any, industry in them, and the duration of outage due to transmission troubles rarely exceeds an hour, this item is considerably less important than its area on the diagram would indicate.

One can, with some measure of assurance, use Diagram No. 2 as a basis for consideration of improvements because it covers territory which is uniform in character and service facilities which are all much alike. Also, it is useful in establishing the composite result of distribution outages which cannot be considered by whole circuits because so often only a part of a circuit is in trouble.

I would say a word of caution about outage studies in general. They only show how bad our service is. There is danger in studying only the outages on a system in that one easily forgets how small a proportion of the time, at worst, the service is off. We should also consider how good our service is.

Diagram No. 3 is a form of record chart for outages of bulk power, transmissions, and substations for any given substation which literally shows how *good* the service is. This chart can be made up in small card form and can cover a number of years if desirable. By using colors or a code, the outages can be classified as to the part of the system where they originate. It shows time of day, time of year, and duration. We are considering the use of this form because it does automatically carry its own performance background. It has one limitation which is that distribution outages cannot be recorded on this card because most all of them affect only a part of the customers fed from this substation or from any one distribution circuit out of the substation.

The source of the performance data on which the above analyses are based is, of course, the actual operating record of the lines, substations, etc., and the keeping of adequate system operating records is very important. We have found that it is advisable to keep a separate operating record for each section of transmission, each substation, and for primary circuit troubles on each distribution line. Distribution transformer troubles and secondary troubles are not separated by circuits but rather between city and suburban territory, which amounts broadly to a division between the secondary banked operation in the city and the radial operation in the country. While, at first thought, this might seem like a great amount of record keeping, experience has indicated that once it is established it can be standardized and handled at very little cost.

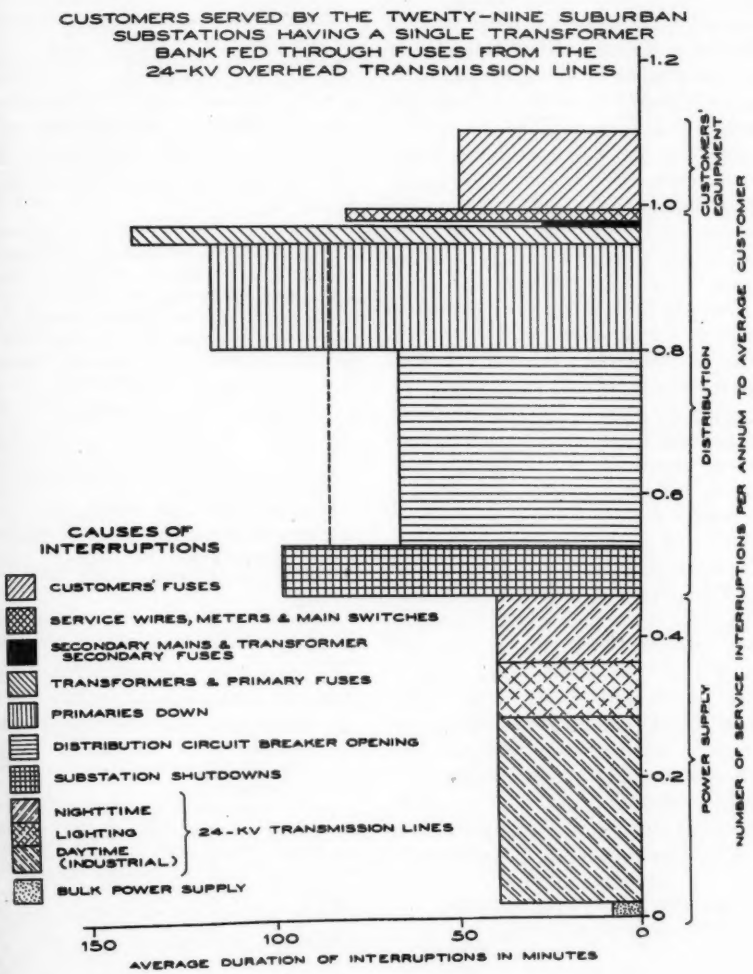
Measures Available for the Reduction of Service Outages

To go along with an understanding of the importance of individual outages and of the general system performance background is a knowledge of the means at hand for the elimination of these outages, the cost of applying them and some measure of the results which might be expected.

You are all familiar with the majority of the devices and methods at hand but there are a few interesting ones which, though not new, have not come into general use, as far as I know.

SUMMARY OF LONG SERVICE INTERRUPTIONS
ON DISTRIBUTION CIRCUITS
1933 TO 1936 INCLUSIVE

DIAGRAM No 2



One of these is the reclosing pole top switch for use in sectionalizing overhead transmission lines. We employ it for our 24-kv overhead transmission system. The ordinary procedure is to install two manually operated pole top switches, one one each side of the tap to a small substation so that, in cases of persisting trouble on the lines, an operator may be sent to sectionalize the transmission line and connect the substation to the live end. There has been developed apparatus to be used in connection with these switches which will cause them automatically to do the same thing an operator would do were he there and in constant communication with the system supervisor. It operates as follows: Through potential devices connected to the 24-kv overhead transmission line on the line side of each of the pole top switches, the switches will drop open after a predetermined time should the voltage on the line fail. This cuts the line in two and isolates the substation. Either pole top switch will reclose upon the return of three-phase potential to its supply line. Thereby the substation is connected to the live end as soon as it is made alive. If the trouble on the transmission line is of a transient nature and both ends become alive, both pole top switches will reclose, reestablishing the through continuity of the line as well as the feed to the substation. The cost of this equipment is approximately $3,500 per pair of pole top switches. Except in rare instances, it reduces all long outages to approximately one minute duration. Note that it does not eliminate any outages but merely makes the long ones into short ones. Note also that it affects only transmission outages. One is still faced with outages caused by troubles in the substations as well as the distribution outages. It is quite simple to tell from the operating record of any particular substation just what an investment in such a pair of switches will do by way of improved service to the customer.

Another expedient sometimes used on distribution lines, having large exposure, is to sectionalize the primary line with fuses so that a defective piece of line can be cut off without shutting down the entire circuit. Experience has indicated that with bare primary wires spaced well apart many transient troubles will clear themselves, given sufficient time. Therefore, it is quite possible that, whereas, the fusing of a branch may occasionally save the entire circuit from a shutdown, the very presence of the fuses may, by reason of their inability to hold on long

SUBSTATION TAYLOR LONG OUTAGES FROM 1930 TO 9-20-38

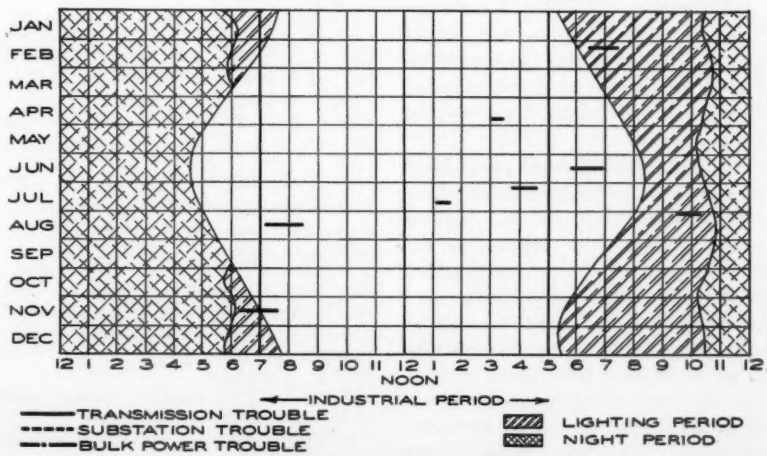


DIAGRAM No 3

enough to give transient faults time to clear, result in more aggravating outage to customers than were the fuses not there. To be sure reclosing fuses are available but they require a good bit of watching to insure their being always ready for service. An initial step of very quick opening and reclosure on the substation circuit breaker will sometimes put out the transient fault before the sectionalizing fuses blow, and has the advantage of being self-restoring. While this idea is not new, experimental work is being done in this direction on our system.

I might name other methods but these will suffice to illustrate.

The Judgment Factor

Having set up the system performance record, evaluated the various means available for the reduction of interruption, and applied them to specific cases, the problem is not yet solved. The question of whether an expenditure, no matter how well defined as to amount and results, should be made is still a matter of judgment. There are many factors to be taken into consideration, not least among which is the psychological reaction of the customer to the particular troubles in hand. A violent lightning storm, a hurricane, a big fire or explosion are occurrences which a customer understands. Oftentimes, disastrous outages from such causes are turned to very good account if the situation is intelligently handled and service is restored quickly. In many instances the power companies have been complimented by their customers on the expeditious handling of spectacular troubles of this character. On the other hand, repeated outages from causes which the customer cannot understand, particularly if he suspects that they are due to carelessness or indifference, will almost always be irritating to the customer. Repeated shutdowns for maintenance work and the like are a common cause of dissatisfaction.

Very rarely does any one department or division of an operating company have a sufficiently well-balanced view of the general picture to pass judgment on the wide variety of reliability situations. I think it is fair to say that sales representatives usually take undue account of specific instances of trouble because they must so often deal with dissatisfied or exasperated customers. Operators are too often inclined to strive for perfect operation under all conditions, at the expense of undue investment. Construction men are likely to be unduly influenced by the difficulties encountered at the time of construction without giving sufficient consideration to the long years through which the structure must operate satisfactorily. The engineer is prone to think in terms of statistics and average, despite the fact that he knows that human beings and human activities do not lend themselves to averages. The controller is inclined to want to keep the investment at a minimum, perhaps at the expense of results which the sales department and the operating departments feel to be essential. All of these points of view are necessary and in most instances should be brought to bear on the problem of reliability investment.

In an attempt to take all of these viewpoints into account, we are now trying what we term an Interruption Study Committee. The Committee is comprised of the Superintendent of the Electrical System who has general responsibility for electrical operation and maintenance as well as for the planning of extensions to the system; the Sales Manager; the Superintendent of Lines who has custody of underground and overhead lines, both as to operation and maintenance; and the Planning Engineer who acts as Chairman. It is the business of this group to consider the various causes of customer outage, to weigh the remedies and their cost and to make recommendations to the General Manager.

The following is a typical problem of the kind laid before this Committee:

INTERRUPTION STUDY COMMITTEE

Item 8-A

24-Kv Reclosing Pole Top Switches for Suburban Tap Type Substations

We are now in position to give a fairly accurate statement of what results may be had from the use of 24-kv reclosing pole top switches in several of the tap type suburban substations.

It might be well to state again just what the reclosing pole top switches will accomplish.

1. They will reduce the duration of the long outages caused by 24-kv transmission lines from some thirty or forty minutes to a minute or two.

2. They will not reduce the number of such outages, nor will they make any difference in duration of the short outages, namely, those in which service is restored simply by reclosing the 24-kv circuit breakers at the feeding substations.

3. They will not affect any outages caused by troubles within the substation.

4. They have no effect on distribution troubles.

You can get some idea of the proportions of the above classes of troubles from the outage diagram which you already have. This diagram shows the number and duration of outages by causes, to the average customer on these tap type substations.

As you know, we are planning to install a set of these pole top switches at Bear Point. In the following list is given the expected performance at Bear Point as well as at several other substations. You will also note that we have taken account of the time of day in which 24-kv transmission outages occur and have divided them into the lighting period, the daytime industrial period, and the night period from 10:30 P. M. to 6:00 A. M.

Also, we have not included in this operating record the very bad storm of August 2, 1934, because reclosing pole top switches or any other similar device could not have protected against the almost complete loss of 24-kv transmission which occurred in the affected district. To include the effects of such a storm would be misleading.

BEAR POINT SUBSTATION

Customers 2,014
Secondary customers of 25 kw or more 1
Primary customers 1
Street lighting circuit 1
Includes Harsen's Island and St. Clair River range lights.
The Gross Revenue during 1936 was $80,000.
Long Substation Outages caused by 24-kv transmission, January, 1932, to date (5½ years).
During lighting period 0
During daytime industrial period 3
(Ranging from 25 minutes to 2 hours and 5 minutes).
During the nighttime 1
(37 minutes).
For an expenditure of $3,500 to make the present 24-kv pole top switches reclosing, the above outages could be reduced in almost all cases to some two minutes' duration.

DEER PARK SUBSTATION

Customers 996
Secondary customers of 25 kw or more 2
Primary customers 1
Street lighting 2
Includes Village of Dryden.
The Gross Revenue during 1936 was $60,000.
Long Substation Outages caused by 24-kv transmission, January, 1932, to date.
During lighting period 0
During daytime industrial period 2
(One 10 minutes and one 56 minutes).
During the nighttime 0
Also had two bushing failures which would not be affected.

At what point we should "draw the line" on reliability expenditures, we do not now know. As far as may be, the cases will be considered in descending order of importance until, all things considered, the proposals cease to be convincing. That will be the stopping point. Where that point may be will vary with different companies, different situations, and different points of view, but so far this approach has worked well for us.

Discussion of Mr. Dean's Paper

By R. A. Hentz
Philadelphia Electric Company

AN electric utility must provide a plant that is adequate to serve its customers. From an engineering point of view, the three main measures of plant adequacy are as follows:

1. Does the equipment have sufficient capacity so that the customer's demand in amperes will not injure it?

2. Is the plant so designed that the voltage delivered to the customer is within reasonable limits (normal voltage is usually prescribed by Public Utility Commissions).

3. Is the continuity of service such that the customer is satisfied with it? Otherwise his attitude may result in poor public relations, reduced use of our service, and in the case of industrial customers, even loss of the customer's business entirely.

The investment which can be justified to improve service continuity is frequently difficult to determine. A degree of service continuity which would be quite satisfactory for one class of customer might be entirely unsatisfactory for another. Furthermore, the cost of providing about the same degree of continuity to two different customers in the same class may be such as to render one customer unprofitable. In the Philadelphia Electric Company we have a few guides to help us in this difficult matter, but no set formula for expenditure of money. In the following discussion, consideration is given to various portions of the system individually, except the reserve generating capacity required, as this is a subject in itself.

Substation supply lines and primary distribution in the Philadelphia Electric Company's average urban territory are quite different from that in the average suburban section. In the urban area, substations are supplied largely by 13-kv underground cables, and primary distribution circuits are two phase, 2300 volts. In suburban areas, substations are generally supplied by aerial 35 kv circuits and primary distribution circuits are 4 kv, three phase. Furthermore, both supply lines and primary distribution circuits in the suburban areas are much longer than those in the urban section. These differences frequently make it necessary to apply different remedies to secure adequate service in the two types of territory.

The following table presents some approximate data that we have available to serve as a guide on what portion of the system we can best afford to expend money:

	Approximate Minutes Outage per Year			
	Suburban		*Philadelphia*	
Cause of Outage	*Single Bank*	*Multi-Bank*	*Single Bank*	*Multi-Bank*
Source	9	3.1	4.1	3.7
Transmission	105	3.9	19.1	0.1
Substation	25	0.3	5.0	0.1
Distribution Primaries	58	58.0	2.6	10.5
Distribution Transformers	4	4.0	1.6	1.4
Miscellaneous*	8	4.8	7.4	1.9
Total	209	74.1	39.8	17.7

* Includes operating errors, failure of other customers' equipment and other P.E. substations, emergency switching such as switching due to fires, etc.

Generating Stations and Transmission Substations

Source outages do not cause a large proportion of the outage minutes but justify careful consideration due to the large number of customers affected.

Distribution Substations

At the present time we are maintaining a five year moving average of distribution substation outages. This record shows the number of individual outages, the number of outage minutes, and a product of the outage minutes and kv-a peak load for each substation. Outages are classified in four ways:

1. Source outages (such as generating station or transmission substation loss).
2. Supply line trouble.
3. Distribution substation trouble.
4. Miscellaneous.

For the suburban area, an average rate of interruption, as well as an average length of time out, is worked up for groups of substations with various sized loads, such as those with loads from zero to 500 kv-a, 500 to 1000 kv-a, 1000 to 2000 kv-a, etc. The following table presents this group of averages:

Summary of Suburban Area Substation Interruptions—Classified by Size Groups

Interruptions per Year per Substation			
Mv-a Load	*Number*	*Minutes*	*No. of Substations*
Over 5	1.23	4.8	8
2 — 5	2.18	11.0	12
1 — 2	3.71	31.4	7
0.5 — 1	8.47	160.3	14
0 — 0.5	9.84	182.7	24
Average	6.41	108.0	65

In reviewing the need for improving service to individual substations, the above tabulation is used to determine whether a particular substation is out of line with the service secured by the average substation. If it is extremely far out of line, it naturally becomes a candidate for service improvement. The one most out of line ordinarily will get first consideration when the money is available for such purposes. You will notice that the smaller substations have substantially poorer service than the larger ones. This fact, together with our outage minutes times kv-a peak factor method of analysis indicates that we recognize that it is usually not economically feasible to provide the same degree of service reliability for small loads as for large loads.

13.2 and 33 Kv Lines

Most of our 13.2—33 kv lines are routed direct to distribution substations with no intervening load tapped off. In such cases, we do not generally consider additional expenditures for service reliability unless the service to the substation supplied by one or more lines is substantially out of line with the average substation of about the same size. For the smaller group of lines which either serve individual customers only or those which supply customers while en route to a substation, the service rendered by a particular line to such customers is the general determining factor as to whether service is adequate or not. With underground lines the service reliability is generally so high that outages are very infrequent and little consideration needs to be given to service improvement. With aerial lines however, the frequency of

outages, about ten times that of the underground lines, call for serious study. We have experimented regularly over the past five or ten years with various ideas for improving aerial line reliability and are still experimenting. In practice we maintain a five year moving average on high tension customer outages. If these customers average one or less interruptions per year, no consideration is given to improving the reliability of their transmission. For those with more than one interruption per year, we multiply the kilowatt-hour use per year by the average number of outages per year and secure an "outage-use" factor. From such a tabulation we determine the average "outage-use" factor and concentrate our attention on those above the average. By this method we automatically give some weight to the revenue secured from a customer as well as his outage record. We do not have a fixed formula for determining whether money will or will not be spent to make the "outage-use" factor of a customer in line with the average. Where improvement can be secured for very nominal expenditures, they are made. Where large sums would be required, personal judgment, the magnitude of the cost, and the type of customer's load are important factors. For example, an interruption to a customer with a processing plant, such as paper making, is given more consideration than others because such interruptions result in substantial loss to the customer involved.

Distribution Circuits

The average urban distribution circuit from a multi-bank substation has about one-fifth as many interruptions due to troubles on the circuit itself as a circuit in the suburban area as shown by the first table. For this reason, we do not feel justified in spending extremely large sums for sevice improvements on the circuits in our built-up areas. We do, however, spend nominal amounts from time to time. For instance, on a circuit which branches in two directions at or near the first distribution transformer it is frequently possible to tie its two branches together without fuses near the end of the circuit by stringing only a few spans of wire on existing poles to form a loop. We find that such looping improves service in that wires down on the street frequently do not result in tripping the breaker at the substation. The loop will render continued service to all customers under such conditions.

In suburban areas, we believe that service should be improved and we have been experimenting with two kinds of primary networks, as follows:

(1) With 600 to 1200 kv-a capacity single bank substations as a source (usually on pole platforms) without fuses in the covered wire loops between substations and with a low tension substation breaker set to trip on reverse power only.

(2) With a limited number of 4 kv radial circuits as a source and with fuses in the bare wire loops.

Networking the single bank substations has given us better service than that expected from the two-bank two-line substation planned for this area at less than half the estimated cost. However, it has been applied only to low load density areas (about 100 kv-a/sq mi). We have great hopes for getting substantial service improvements by these methods at moderate cost.

Distribution Transformers and Secondary Wire

To date we have concentrated on the installation of lightning arresters for distribution transformers in exposed locations where the cost of arresters is generally more than offset by the saving which results from their installation. In the future it is quite possible that we may install some even though they cannot be installed on an economy basis alone. Trouble on secondary wire which results in customer outages are so infrequent that they could be called rare. For this reason no consideration is given to increased service reliability on this portion of the system.

Conclusions

As time goes on greater and greater dependence will be placed upon electric service both in industry and in the home, and particularly the latter. This means even greater attention must be given this general subject of reliability.

Discussion of Mr. Dean's Paper

By H. S. Fitch
West Penn Power Company

WEST PENN POWER COMPANY serves the Southern and Central sections of Western Pennsylvania, surrounding the Pittsburgh Metropolitan area on three sides and covering a total area of 9,000 square miles. Unlike the system of the Detroit Edison Company which serves a large city, the West Penn System serves numerous towns and small cities, the largest of which is Washington, Pennsylvania, containing 25,000 people. The total number of customers served is 210,000. The type of load differs from that of most companies because of the high proportion of industrial business which makes up about 70% of the total, the residential load only about 8%. The industrial load is composed principally of steel which is 35% of the total, coal 32% and glass 13%.

Because of the large number of small towns and many industrial customers served, the large substations are only those stepping down from the 132 kv transmission system. There are 29 distribution substations with 24-hour attendance, 56 automatic distribution substations, and over 100 transformer stations of moderate sizes up to 1,000 kv-a on the 25,000 volt system, some of which are controlled by automatic operated airbreak switches.

As Mr. Dean well says, "One must first know thoroughly the present quality of one's service."

For over 20 years we have maintained an elaborate interruption record of the feeders served from the attended and automatic substations. About five years ago we expanded this record to include every feeder extending from every step-down station, thus including many feeders that are protected only by fuses. Our present grouping of the service rendered by such feeders or services includes 42 different classifications developing a break-down for interruptions caused by sources of power, interruptions caused within the station itself, and interruptions on the feeders served from these stations. A summary for the the system is made annually which sets forth clearly the relative record of the

various units of service, after which conferences are held to determine the causes and what changes are needed to improve the particular situation and to apply this improvement to other similar situations where interruptions to service might develop.

We agree heartily with the statement in Mr. Dean's paper that interruption records tend to magnify service outages. For that reason the data covering such records should be confined to the use of the company. Several companies in Pennsylvania have adopted a phrase "Service Continuity Record" to evaluate how good service is, as contrasted to interruption studies which emphasize the other side of the picture. The formula for Service Continuity Record is as follows:

"The total number of minutes in the period being studied, times the total number of units on the record, minus the total number of minutes interrupted by each of these units, all divided by or over the total number of minutes in the period being studied times the total number of minutes in the record."

For this type of formula the Service Continuity Factor has to be carried out to three or four decimal points for invariably the record, except on rural lines, will be better than 99.9% perfect.

The System Operating Committee of the Pennsylvania Electric Association has attempted to standardize the method of maintaining interruption records, but it has been found impossible to do so. The principal point of contention seems to be bound up in the question whether a record of the number of minutes each service was interrupted is sufficient to obtain a system total, or whether these interruptions should be evaluated by multiplying the minutes interrupted by the load served. Actually the relative record for systems as a whole under the two methods varies but little.

It is the fate of the Power Company to be blamed usually for everything that happens to interrupt the service even though the cause of interruption may be beyond their control or beyond elimination by any reasonable investment or even in the plant of the customer served. Therefore, while a record is a statistical method of evaluating the causes of interruptions in various ways—42 in our case—one must determine after every interruption of any importance, by inspection, just who is harmed by the outage, and how much. I know of no other way for an operating manager to gain a clear view of his problem, magnified greatly by the customer's complaint and usually transmitted through a sales executive.

The engineer cannot always get to the bottom of the situation. For years I have had reporting directly to me a corps of graduated load dispatchers who constantly visit the customers, inspect our equipment and their plant and who are charged with the responsibility day or night, weekday or Sunday of being on the job quickly enough to get the important first-hand facts, before the alibiing is done or the repairs made hide the true picture. These men by their tactfulness, firmness and instruction have won as friends the very men in the customer's plant who formerly told their boss how bad our service was and not how poorly they restored their machines to service after a surge or short interruption. And many times by this type of inspection and association with the rank and file have we forwarned the customer of pending trouble and secured for his own operators the improved equipment which they were afraid to ask for.

On the other hand, every feeder interruption has something in it of value, if nothing more than experience or a point in the service record, and if it is carefully reviewed by the inspectors, the System Operator, the Relay Engineer and the Station and Lines Maintenance Engineers, as we require, one can be reasonably sure a remedy will be suggested.

Now, as Mr. Dean says, here is where the exercise of judgment is an art. Suggestions are many, but the appropriation for such improvements will cover only a comparatively few. The conference of the interested engineers, operating and sales, or what he calls the Interruption Study Committee, is to mind the best and only satisfactory approach.

With the type of load we serve and with so many automatic substations, we are progressively installing very rapid or immediate reclosing breaker schemes and are incorporating at the same time very rapid but not instantaneous tripping. We have followed the work of Mr. J. T. Logan of the Georgia Power Company with considerable interest and believe that he has proven by the record of many outages that one solution is to apply fast tripping and immediate reclosing to the feeders. Our experience is that the customers under these conditions very seldom realize that there has been an interruption and we have many many records of synchronous machinery pulling into step without tripping off the line, especially in the case of air compressors where the relays to the unloaders are carefully adjusted. Inasmuch as the records over the country show that over 70 per cent of the feeders that trip can be restored to service immediately, this inexpensive solution is a very attractive one. This type of relaying also permits the restoration of service not only from the same feeder, if it tests good, but from a separate source of power, if the feeder tests bad and all before the customer realizes there is an interruption. We have in successful operation several important feeders that are thrown over to the neighboring systems in the event of trouble on our own.

Using methods similar to those described by Mr. Dean we are increasingly making our pole top switches automatic to sectionalize lines and transfer customers from one feed to another. Where both switches are closed at an industrial substation or where flop-over service is applied, we retard the operation of the switches to sectionalize the line or to transfer the service, long enough to make one test at the automatic reclosing station.

In our last installation we adopted remote control, utilizing apparatus developed for fire signal systems and the Bell Telephone cables. This line between an attended and an automatic station serves very important glass, steel and chemical load. Sectionalizing of all major services at three points is provided at the attended station for a total cost—not including switches—of $3,500. The switches were already installed and whereas formerly the fastest sectionalizing by the service men would be at least 20 minutes and running as high as 50 minutes at night, now the whole line can be sectionalized in not over two minutes. I foresee such a type of installation increasing in number, although it has the disadvantage of manual operation.

Although our experience with Reclosing Cutouts has been relatively limited, an article in the October, 1938 issue of *Electric Light and Power* apparently covers the present situation as regards these devices very completely and states that "statistics indicate that two shot reclosers will restore service in 48 per cent of all cases of distribution feeder outage and that three shot reclosers will restore service in 61 per cent of all outages." Surely, it is not difficult to appreciate the economic justification of such a device.

Upon our system, in the majority of cases, we have relayed our automatic

feeder breakers to provide one reclosure before the fuse blows. In other words, we prefer to interrupt the whole service for one second in order to try to pick up the branch circuit in trouble. The second tripping of the breaker is delayed to allow the fuse to blow.

Having been an operating man nearly all of my utility life, I believe as all operating men should, that the quality of service, like the quality of mercy, should not be strained. But one cannot proceed far on this premise without coming into collision with the hard facts of investment, especially in these days when money is so difficult to get. On the other hand, the type of service that is just good enough to get by is not the goods we want to place in the brief cases of our sales engineers. Therefore, as Mr. Dean has summarized, know your service, confer frequently over its shortcomings with all the facts on the table and measure out carefully your budgeted allowance. If all parties are in 100 per cent agreement before each improvement is made you will find that many of the cases will be rejected before they ever reach the conference table because of the principles already established.

Statement to the TVA Investigating Committee

(*Continued from page* 468)

tors in the country's recovery. It would take thousands of men off the relief rolls and add them to the payrolls. It would reduce the national tax burden. It would provide a market for the heavy industries which have lagged far behind other businesses. It would electrify the security markets, give the investor new confidence and promote the lifegiving flow of capital into all forms of industrial enterprise.

What then, should be done to achieve this desirable condition? Of course, it is my personal belief that the TVA should go out of the power business and confine itself to its functions of flood control, navigation and soil conservation. I have always been convinced that the power activities of the TVA violate the Federal Constitution by putting the Federal Government in a business it is not authorized to engage in, thus destroying the property and business of its citizens. It is my view that the soundest solution both for the government and the utilities would be for the TVA to dispose of the power generated by it to the utilities at the switchboard. The utilities would then distribute it to the consumers under Federal and State regulation. This in my judgment would insure the widest possible distribution of the government generated electricity, and would not confine the use to selected, favored localities.

I am not hopeful, however, that those administering the TVA or many of you share these ideas. But if the TVA is not to go out of the power business, then at least we can agree on this fact: that the enormous public loss of duplicating existing utility systems should be avoided, that the TVA should buy the utility properties in their entirety in its area at a fair price and that the area in which it intends to operate should be clearly defined.

As you know, we have made repeated proposals of this kind since 1933 but it was not until the spring of this year that the TVA began negotiations with us for that purpose. One of the basic questions involved is, of course, the value of the properties offered for sale. Apparently this is a question which your Committee intends to consider. As you know, your counsel has secured Presidential authority to inspect our income tax returns, presumably for the purpose of determining the value of our properties. Also, in the list of material which he asked me to bring with me, he has included a great deal of detailed information bearing upon that subject.

Now, nothing in the resolution creating your Committee authorizes it to engage in such a study. There is no mention of it in the enumeration of the tasks to which you are assigned. But this question of your jurisdiction is incidental to the basic fact that the evaluation of these properties is an impossible one for your Committee to undertake. The determination of property values is a laborious and exacting task. There is no question more complex than that of valuation, even in the hands of Commissions which have that as their primary function. Your Committee would be the last to claim, I am sure, that it is a body of experts on valuation. But even if you yourselves cannot determine that question, there is a way of determining it which is suggested in the very resolution of Congress by which your Committee was appointed. In the concluding paragraph of Section III you are specifically empowered to utilize the services of other governmental agencies. I read from the resolution as follows:

> "The joint committee is authorized to utilize the services, information, facilities, and personnel of any department or agency in the executive branch of the Government in the performance of its duties."

It is my earnest recommendation therefore, that the valuation of The Tennessee Electric Power Company properties as an entirety, which is basic to the question of their sale to the TVA and the municipalities, should be referred to the Securities and Exchange Commission.

I know of no other plan which would so effectively expedite this inquiry. If your Committee attempts to turn itself into an informal valuation body, it will simply become a forum for a continuation of the already long debate on this question. You will be forced to listen to the partial and partisan presentation of highly technical figures. There would be no opportunity for orderly arrangement of evidence or for cross examination by legal counsel. Unwittingly you would become the instrument for charges and counter charges, largely designed for publicity purposes, in an effort to make spot news out of such things as the difference between value claimed for income tax purposes and value stated in a corporate report—a differentiation which is standard practice among American corporations and duly recognized by the U. S. Treasury Department. I think you will agree with me that it would be impossible for your Committee to arrive at a fair conclusion from this mass of conflicting and incomplete testimony.

I believe that this difficulty could be met by referring the question of valuation to the Securities and Exchange Commission which has a large staff of experts specially prepared for studies of this kind. In making this suggestion, I am aware of the fact that various TVA officials, in testifying before you, have apparently questioned the sincerity of our offers to sell our utility properties to the TVA and to the municipalities concerned. Obviously, we could sit here for weeks in acrimonious dispute about motives and intentions. But you can solve that too, quickly and easily, if you adopt this proposal.

In other words, the quickest way to test the sincerity of this proposal is to accept it. If you can persuade the TVA at this time to do likewise, I publicly

(*Continued on page* 485)

Ground Line Treatment of Standing Poles

By F. W. Packer
Pennsylvania Power & Light Co.

A Paper Presented at the Transmission & Distribution Committee, E.E.I., Meeting at Old Point Comfort, Va., Oct. 12, 1938

IN these days of intense economy, public utilities are making every effort to provide as continuous and dependable service as possible with a minimum of expenditure. When it is realized that approximately 20 to 25 per cent of the cost of an overhead system is represented by pole structures, one can readily see what an excellent field for economy presents itself by prolonging the life of standing poles. Electric and communication companies have in the past depended a great deal on Nature to provide trees in their natural state for use as poles.

In recent years, methods have been developed for initially treating poles to prevent fungi and termite attacks, thereby preventing decay and providing reasonable assurance of 20 to 25 years life for the poles, except, of course, in some isolated cases. Many companies, however, still have in use an appreciable number of untreated poles in the East, mostly chestnut. The high cost of renewing poles and transferring existing equipment due to ground line decay, has made them decidedly "pole conscious." The claims of greatly extended life made for new poles with various types of full length and other treatments have in recent years been well advertised and need not be reviewed here. This paper will, therefore, be confined to the problem of securing added life from standing poles, most of which never had the advantages of modern treatments and, consequently, in practically all cases, rotted in the vicinity of the ground line while the portions above and below this section remain in relatively good condition.

Various methods of treating standing poles have been developed and many companies are using one or more of these methods. At the Transmission and Distribution Committee meetings held in Cincinnati, Feb. 13-14, 1936, the subject of "Preservative Treatment of Standing Poles" was discussed by various representatives who reported the individual experiences of their respective companies. At that time certain methods of treatment had been tried with some degree of success while many others were still in an experimental stage. It was suggested by the chairman, Mr. W. F. Nimmo, of the Overhead Distribution Group, that after the lapse of two years it would be timely again to review this subject and recite its present status. With this thought in mind, a questionnaire was prepared and sent to various members of the Transmission and Distribution Committee in an effort to collect all the information possible on this subject. Of some 45 questionnaires sent out, 30 have been returned, many members could not contribute any data on the subject and many others have a very limited experience with no definite conclusions as to resultant economies or justification for future continuation of any method to preserve the ground line of their standing poles.

Causes and Effects of Decay

It might be well briefly to review the causes and effects of decay. Generally speaking, decay in wood is caused by low forms of plant life (fungi) which are, for the most part, very fine thread-like filaments that penetrate the wood in all directions. For their existence and propagation these fungi require air, moisture, food and favorable temperatures. Wood destroying insects, such as termites, also cause destruction. Fungi and wood-destroying insects depend upon certain substances in the wood for their food. As they eat away, the wood structure is broken down and weakened until it becomes a soft, crumbling mass, powder-like in form. This form of decay is commonly spoken of as "dry rot" and "wet rot" and is frequently observed in wood structures, poles, fence posts, piling and mine timbers.

Need for Treatment to Check Ground Line Decay

On the overhead systems of power and communication companies there are many thousands of poles set without any ground line treatment and many thousands more with an initial treatment which has outlived its usefulness and decay is setting in. Decay starts very easily in this unprotected area and sometimes progresses very rapidly. If unchecked within a reasonable length of time, such condition will require replacement of many poles which otherwise could have given many years of valuable service and obviously appreciable savings to the operating companies. Arresting this decay at the very outset and preserving the original pole strength at the ground line will considerably prolong the life of such poles and make it ultimately necessary for the condition of that portion above the ground line to determine when replacements are necessary. Anyone contemplating extensive pole treatment will find it pays dividends to have an organized and planned program in advance and handled by men who, from practical experience or otherwise, have a fair knowledge of wood and timber.

It is apparent from the experiences of many companies, including that of the writer, that a thorough, systematic program is of prime importance to insure the most economic procedure to follow, which might take any one of the following courses:

1. Treatment of the wood to arrest decay on those poles having sufficient strength in the remaining good wood.
2. Bridging the deteriorated section having insufficient strength, with a suitable reenforcement.
3. Eliminating the pole if practicable.
4. Replacing the pole.

Methods of Preservation

For the past 150 years or more scientists have been experimenting and perfecting various methods of wood preservation. The fundamental principle of all widely-used treatments is the application of some toxic chemicals or oils to the wood in an effort to poison the food of the wood-destroying fungi and insects. This may be accomplished by injection under pressure, or application to the surface of the pole, depending on the principle of capillary action for the absorption of the toxic material after the pole has been properly cleaned of all infected wood. So far as known, any method re-

TABLE I—TREATMENT OF STANDING POLES—CONDENSED DATA FROM QUESTIONNAIRES

COMPANY	NUMBER OF POLES IN SERVICE				ANY REGULAR INSPECTION TO DETERMINE POLES TO BE TREATED. IF SO, WHAT FREQUENCY	ANY DEFINITE PROGRAM FOR TREATING STANDING POLES	METHOD OF SUPPLEMENTARY TREATMENT AND NUMBER OF POLES TREATED						EXTENT OF TREATMENT ABOVE AND BELOW GROUND	WHICH METHOD PROVED MOST SATISFACTORY FROM EXPERIENCE	ARE TREATMENTS EFFECTIVE FOR TERMITES	ARE TERMITES SERIOUS
	TOTAL	NO TREATMENT	INITIAL TREATMENT	SUPPLEMENTARY TREATMENT			CHARRING AND SPRAYING	OSMOSE	ANACONDA W.P.&P.	PERMO	CREOSOTED FELT WRAPPING	ALL OTHER METHODS				
PENNA. POWER & LIGHT COMPANY	341,700	141,600	200,100	119,438	no	1st Supplementary Treatment after approx. 10 years followed by 5 yr intervals	106,080	12,804	90	14	0	450	Charring & Spraying-3" to 6" above to 18" below. Osmose 12" above to 12" below	Insufficient Experience	no	no
PHILADELPHIA ELECTRIC CO	—	—	—	—	Suburban Areas-3 yr periods. Urban areas no fixed interval.	Selected at random.	—	—	27,000	—	—	—	From slightly below ground to 24" below	Experience with Anaconda W.P. Paste only.	No direct evidence to indicate effectiveness.	no
KANSAS GAS & ELEC CO	68,000	0	66,000	1,800	No Standing Poles not Treated since 1933	no	—	—	300	—	—	1200	Hot Creosote & crank case oil 36" above to 18" below. Anaconda W.P. 6" above to 24" below	Hot Creosote Cheaper to apply	yes	yes
UNION ELEC CO OF MO.	33,650	4,000	29,650	518	no	no	—	18	—	—	—	500	12" above to 30" below	Osmose	no	no
BOSTON EDISON CO	91,000	8,500	82,500	188	no	None Creosote Pine Since 1932	—	110	34	—	—	34	6" above to 18" below	Anaconda	Partially	no
VIRGINIA ELECTRIC & POWER CO	114,906	27,046	87,860	4,000	Bad Poles Noted by Regular Patrol	High voltage lines and where transfer costs are high	1,000	3,000	—	—	—	—	12" above and 12" below	Hope for good results with Osmose	Insufficient experience	yes
CINCINNATI GAS & ELEC COMPANY	129,135	9,231	119,904	12,846	Regular Inspection every 8 Years	System laid out in sections, Inspection every 8 yrs.	—	—	10,846	—	2,000	—	6" above and 24" below	Creosote Anaconda satisfactory but dangerous	—	no
THE DETROIT EDISON CO.	800,000	180,000	360,000	6,000	Inspection every 3 or 4 yrs for pole replacement	no	—	5,700	100	—	—	200	6" above and 18" below	Insufficient experience	—	no
CONSOLIDATED EDISON CO OF N Y INC	114,000	92,000	22,000	2,000	no	no	—	2,000	—	—	—	—	About 18"	Insufficient experience	—	no

quiring pressure treatment is too costly, except on newly purchased poles.

Charring and Spraying

The most widely used method for the treatment of standing poles is the charring and spraying method. While other methods have been tried with some degree of success by various companies, the charring and spraying method has been used very successfully in Pennsylvania over a period of approximately 21 years. The Pennsylvania Power & Light Company have treated approximately 115,000 poles in this manner during the last three years at an average cost of $1.16 per pole. Cleaning and conditioning of present poles prior to the charring and spraying are costing approximately $0.20, most of which labor expense will be saved in the future cycle of treatments and result in a unit cost approximating $0.95 to $1.00, at present labor rates.

In treating standing poles in this manner, the earth surrounding the pole is excavated to a depth of 18 in. below the ground line. The section of the pole from one foot above the ground line to 18 in. below ground line is then cleaned by the use of a hatchet and long-handled chisel. All chips and refuse are removed, after which the surface of the pole is charred by use of a torch (burning a liquid gas known as Hopane), which quickly evaporates excess moisture found near the surface, opens up checks and cracks and produces a coating of charcoal which tends to reduce decay and readily absorb preservatives. Creosote, heated to a temperature of 185 to 200 deg. F. is sprayed over the entire cleaned surface of the pole under about 40 lb. pressure while the charred section is still hot and until the pole surface, including all cracks, is completely saturated. Poles are not back-filled until the pole has been permitted to dry for 24 hr. or more. The most favorable time of the year for this application is between May 15 and Oct. 1.

Osmose Compounds

The use of Osmose Compounds seems to be quite general. Briefly, the Osmose process consists of covering the surface of the wood with a patented paste compound containing such well-known preservatives as sodium-fluoride, dinitrophenol, sodium bichromate and a glutinous colloid and then depending on the natural phenomenon of osmosis to secure penetration. The wood to be treated should contain a reasonable percentage of moisture and, since a large number of standing poles are usually wet in the vicinity of the ground line, it is believed that this method may prove to be quite effective. The most favorable time of the year for this application is from April 1 to May 15 and Oct. 1 to Dec. 15 or until the ground freezes.

To treat a standing pole in this manner, a hole is dug about 12 in. to 18 in. deep around the pole and the outer surface cleaned of all decayed wood, after which the preservative compound is applied with a brush. Then to protect and retain the compound, a waterproof paper bandage is wound spirally around the treated area and secured with tacks. After this, the hole is back-filled, completing the treatment.

The Pennsylvania Power & Light Company to date have treated about 18,000 poles by this method at an average cost of $1.24 for both labor and material. Of this amount, 40 cents represents the cost of the material. Recent analyses of increment borings removed from poles treated in this manner have shown encouraging results as to penetra-

TABLE I—(CONT.)—TREATMENT OF STANDING POLES—CONDENSED DATA FROM QUESTIONNAIRES

COMPANY	KIND OF TREATMENT USED FOR BUTT ROT	IS IT ADVANTAGEOUS TO GIVE SUPPLEMENTARY TREATMENT TO PRESSURE TREATED YELLOW PINE POLES AS FOLLOWS: CREOSOTE	ZINC META ARSENITE	ANY OTHER	APPROXIMATE COST PER POLE FOR EACH METHOD OF TREATMENT: CHARRING AND SPRAYING	OSMOSE	ANA-CONDA W.P.& P.	PERMO	CREOSOTED FELT WRAPPING	ALL OTHER METHODS	AVERAGE NUMBER OF MEN PER TREATING CREW	MISCELLANEOUS COMMENTS
PENNA. POWER & LIGHT CO	None Expect to try Osmose	Insufficient experience			$1.18	$1.24	$2.00	$3.80	—	$0.70 to $0.90	11	Experience has shown that preserving standing poles at the ground line pays. Have had insufficient experience to determine the most efficient method. The choice seems to lie between charring and spraying and Osmose.
PHILADELPHIA ELECTRIC CO	none	no experience			—	—	$2.10 (approx)	—	—	—	From 2 to 5 men	None
KANSAS GAS & ELECTRIC CO	none	No	No	No	—	—	$1.80	—	—	$0.40	2	In general not very remunerative for us to treat standing poles. Poles in need of such treatment can have life prolonged only about 5 yrs. at best and possibly only 2 or 3 years.
UNION ELECTRIC CO OF MISSOURI	none	no experience			—	$10.00	—	—	—	$8.00	7	Have not made determined effort to treat standing poles except in a few special cases so experience and knowledge is very limited.
BOSTON EDISON COMPANY	none	No	No	No	—	$3.10	$2.11	—	—	$1.06	5	Supplementary treatment not adopted on large scale because poles purchased in recent years have initial full length treatment. Tests of supplementary treatment now in progress do not show conclusively that life is prolonged sufficiently to justify widespread application of the treatment.
VIRGINIA ELEC & POWER CO	none	No	No	No	$1.75	$2.60	—	—	—	—	4	We believe a company should treat their own poles or if done by contract the company should have their own inspector on the job.
CINCINNATI GAS & ELEC CO	Bore hole & inject Creosote	No	Yes	—	—	—	$4.00	—	—	$5.00	6	None
THE DETROIT EDISON CO.	Osmose	No necessity	Very few on system	No	—	—	—	—	—	—	2 and 4	No regular program for treatment of standing poles. A number have been treated experimentally with various treatments particularly Osmose. Experience too short to afford authentic data on life, costs, etc.
CONSOLIDATED EDISON CO OF N Y, INC	none	no experience			—	$5.00	—	—	—	—	2	Experience with Osmose covers two year period. This is not long enough to draw definite conclusions regarding its merits.

tion and of a concentration sufficient to arrest decay. While this method does not have the proven background of the charring and spraying method, it is hoped that time and experience will justify its continued use and that the ground line condition of the poles will be preserved for a period of 6 to 8 years with each application.

Anaconda Wood Preservative Paste and Pellets

Anaconda Wood Preservative Paste and Pellets have been used to some extent with varying degrees of success. However, when applying this method of treating poles, care should be exercised as prescribed by the manufacturer to safeguard persons and/or cattle from coming in contact with the poisonous compound or the polluting of neighboring water supplies. The cost of applications of this character appears to average between $2.11 and $4.00 depending, of course, on the size of the job.

Coal Tar and Water Gas Tar

Investigation has shown that both coal tar and water gas tar, by-products of illuminating gas manufacturers, are of some benefit in treating poles in scattered locations. These tars have a pronounced toxicity and it is unnecessary to heat them to facilitate application because, when thinned by the addition of creosote and gas-main drips, they are in a liquid state even in extremely cold weather. Their chief attribute is that of low cost, the average unit cost for treating 3500 poles in this manner having been about 65 cents.

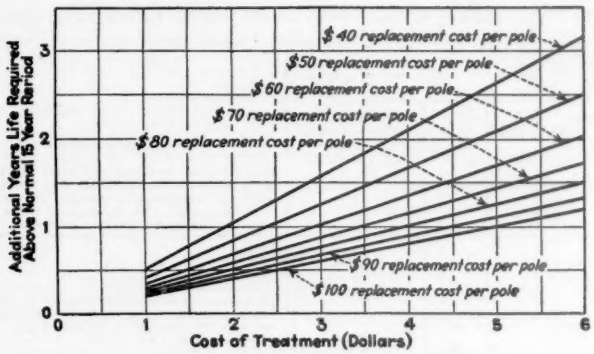
These tars can be applied by first forming a small cone-shaped opening around the pole to a depth of about 6 to 8 in. with the use of a special wedge-shaped tool. Usually a mixture of creosote and coal gas tar is then poured into this opening, the theory being that a certain amount of the preparation will be absorbed by the pole and at the same time sterilize the soil surrounding the pole. About 3 gal. of solution is required per pole, which amount appears to fill the recess, thus insuring contact with the wood for a time dependent upon the porosity of the soil. Coal tar costs about 10 cents and water gas tar about 5 cents per gallon. However, the amount of creosote oil absorbed by the pole is questionable and the amount of treating by this method has been on purely an experimental basis.

Permo

Another treatment given a thorough trial was Permo, a manufactured blown asphalt and wax compound. This is a solid black material which, when heated to about 350 deg. F., becomes a liquid, having the consistency of water. Before applying, the ground is removed from around the pole to a depth of about 30 in., all cracks and checks are cleaned with a pointed tool, and all deteriorated wood is removed. A spiral spacer spring is then placed around the portion of the pole in the uncovered section over which a piece of paper, resembling roofing-paper, is placed in tubular form. This is fastened with gummed paper strips and the joints are pinned with T pins. Moist clay is then packed around the bottom of the paper to seal it. After heating to 350 deg. F., the compound is poured between the pole and the paper, the theory being that the excessive heat will drive out moisture, kill all life, and when cool will form a protective shell around the pole which will keep moisture away. Actual application shows that about $2.00 worth of the material is required per pole. It was also found that the material congealed before penetrating very far into checks and cracks, thus leaving voids.

Creosoted Felt Wrapping

In 1935, the Cincinnati Gas and Electric Company developed a new method of applying creosote and have now ap-



Balancing life prolongation against pole and treatment cost

Savings result when the treatment extends the pole's life a greater number of years than shown by the curves above. Assumptions—Fifteen-year normal life; total cost of replacement from $40 to $100; supplementary treatment applied at end of eleventh year; interest on investment, 6 per cent; taxes per annum, 2 per cent; depreciation-annuity factor of 6 per cent.

plied it to some 2000 cedar poles at an estimated cost of $5.00 per pole. While the cost is more than many other methods, the technique is interesting. Briefly, the initial supplementary treatment requires removing the earth around the pole to the depth of about 30 inches. After all rot has been removed, a bandage of absorbent roofing felt, two inches wide, is wrapped around the pole for a distance of about 24 in., with about 3 in. extending above the ground line. The edges of the felt are butted together and wrapped with a thin aluminum tape, 2 in. wide, giving the effect of a bandage around the pole. The bottom end of the wrapping is sealed with a roofing cement and dirt is tamped around the lower section to prevent the escaping of excess creosote. About 2 gal. of creosote is then heated to the boiling point and poured very slowly into the top of wrapping until it becomes saturated. The top of the form is then sealed with roofing cement and the pole is immediately back-filled. The average cost of material, including creosote, is $1.10 and the labor varies according to the condition of the poles being treated. Subsequent borings have indicated a fair amount of penetration and this type of treatment may prove of considerable merit in the future.

Miscellaneous

Many other types of treatment have been tried by various companies but on such a small scale as to render difficult any definite conclusions as to their merit. Such treatments might briefly be mentioned, as follows:

Crank case oil
Pfisterizing
Creosote brush treatment
Zinc chloride treatment

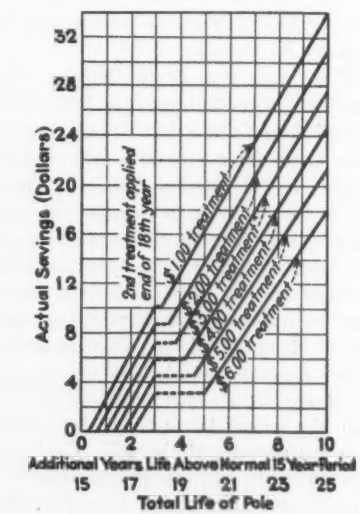
The following additional methods have received general consideration in Canada.

1. Sand-creosote collar method developed by the Hydro-Electric Power Commission.

2. Peat-creosote collar or "Rot-tox" method developed by the Line and Cable Accessories Co.

3. Protective concrete sleeve with pea gravel and creosote developed by the Toronto Hydro-Electric System.

4. Cobra process.



Curves showing actual savings accomplished by the application of various priced supplementary treatments to a $60 pole and based on the following assumptions:

1. Normal pole life 15 years

2. 1st treatment added at end of 11th year and 2nd treatment at end of 18th year

Methods 1 to 3 inclusive are very similar in technique and the supply of creosote can be replenished every 3 to 5 years at a cost of about 50 to 75 cents a pole.

The Cobra process originated in Germany and is a method of injecting toxic salts such as those used in the "Osmose" process into a pole by means of a needle. It is understood that the "Osmose" process was developed from this process and is much easier to apply and is more effective than the Cobra process.

Conclusions

1. Charring and spraying has been employed to the greatest extent by companies engaged in this type of work on a large scale.

2. Osmose Compounds have been found satisfactory only from the standpoint of application and apparent results from some increment borings. Experimental installations have been quite extensive and the next few years will probably furnish data for the general approval or disapproval of this application.

3. Anaconda Wood Preservative Paste and Pellets have proven satisfactory in many cases, although great care must be exercised in their use to safeguard the danger to persons and cattle as well as pollution of any water supplies.

4. Coal gas tar and water gas tar are being used to a limited extent, although this method is not as thorough as some other methods. A small supply of this material can be carried on a truck in a drum and used as a "fill-in" job by a few members of a line crew which otherwise would be waiting until the balance of the crew finished the work being done in that vicinity.

5. All other forms of preservative treatment have been used on such a small scale and mostly in such an experimental manner that no definite conclusions can be formed as to their relative merits.

6. Should circumstances require the setting of a pole without initial treatment, it will be most effective and beneficial to have such pole treated as installed or within a few months afterward.

7. It is apparent from the vast improvement in the technique of preservative treatment for new poles that the necessity for supplementary treatments at the ground line of standing poles will eventually not be a major problem.

Modern Kitchen Bureau Activities

By H. L. Martin

Manager the Modern Kitchen Bureau

WHILE final details of the Modern Kitchen Bureau's 1939 program are still to be developed, preliminary plans as approved by the Executive Committee indicate increasing activity for the Bureau next year.

The 1939 electric range campaign will continue to stress the theme that electric cooking is low cost cooking. It will also be designed to bring more widespread recognition of its speed, safety and cleanliness. Other appeals, such as automatic cooking, and better tasting foods, will be introduced when possible, but will be subordinate to the main theme.

A series of five advertisements supporting this story nationally will appear at intervals in the *Saturday Evening Post,* commencing late in March and continuing into June. The period from April 1 to June 1 will be designated as the "Guess Again Campaign," spotlighting the main sales idea that "Electric Cooking costs one-half as much as you think."

Promotional Materials

Materials now being prepared for the "Guess Again Campaign" include a plan book, window posters, counter cards, letterhead stickers, painted billboard suggestions, newspaper advertising mats, a special newspaper section, a salesman's guide, radio spot announcements, and several contest suggestions. The Bureau's meal-planning book, *Meals Go Modern—Electrically,* will be available for the campaign, as will a new booklet, *The Home Office,* noted elsewhere in this article.

The national electric water heater program for 1939 will again include a series of contests adapted to various interested groups such as salesmen, utility companies, utility executives and dealers. The 1939 refrigeration campaign will offer a series of tested sales ideas and promotional materials. Further details of these programs will be available later.

Electric Roaster Campaign

A new activity under the Modern Kitchen Bureau banner this year will be a national campaign to promote the electric roaster. It will include national advertising and strong promotional and advertising material for local use.

Finally, there will be a new all-electric kitchen campaign to continue the kitchen planning activity for those interested in ensemble selling. Completely new promotional and advertising materials are now being developed and will be available for utility companies and dealers.

The four appliance programs and the combined "over-all" kitchen program offer the most flexible plan possible whereby co-operating agencies of all kinds will be able to profit from popular interest in the modern, electric kitchen. Utilities will want to prepare now for a place in their 1939 budgets for five of the Bureau's programs.

Discovery Month Quotas to be Exceeded

With 122 utility companies actively participating in the Discovery Month program, and with dealers, distributors and manufacturers giving it enthusiastic support, there is every indication that the national quotas of 30,000 electric range sales and 8,000 water heater sales will be exceeded.

Final reports are delayed, because many utilities which have already reported their own sales cannot give complete reports on dealer sales until later. Many companies, too, are continuing their Discovery program into or through November, either because they were obliged to make a late start or because they wish to take further advantage of its effectiveness.

The acceptance of quotas assigned by the Bureau has been genuinely gratifying. Carolina Power & Light Company, for example, announced to its dealers: "In setting our quota The Modern Kitchen Bureau assigned a stiff job to our territory. But the Bureau really doesn't know what we can do when our steam is up. *This is our opportunity to show them!*"

Liberal use of the Bureau's promotional material has been made by all participants. Banners, posters, leaflets, salesmen's guides and other material have been put to effective use in the show rooms of utilities and dealers. Many utilities, moreover, produced their own Plan Books and other promotional material, adapting the Bureau's material to local conditions.

New Booklet

A new 12-page booklet on the modern electric kitchen and its equipment has been prepared to meet the need for an inexpensive promotional piece which can be distributed over the counter or by mail to prospects interested in knowing more about the advantages of electric service in the kitchen.

The booklet, in full colors, is entitled "The Home Office." It points to the dividends that the modern kitchen pays in time, economy, cleanliness and comfort, and devotes sections to the electric range, electric refrigerator, electric water heater, and to the small appliances. A section is also devoted to the arrangement of the three work centers and the advantages of planning. Several types of modern electric kitchens are illustrated.

"The Home Office" contains much valuable information for the homemaker, householder, builder and landlord. It tells the modern kitchen story simply, quickly and forcefully. Utilities and dealers will find it a great aid in telling this story to their prospects and in paving the way for sales. It may be procured on application to the Bureau at $5 per 100 copies. Envelopes for mailing are priced at $2.50 per thousand, and imprinting at $1 per thousand.

The Water Heater Trophy

Some utility company somewhere will be the proud possessor of a silver trophy early next year for doing the best all-around electric water heater job in 1938.

With the trophy will go a cash prize of $1,000, which may well gladden the hearts and fatten the pocketbooks of the employees who have contributed to their company's victory. Both trophy and cash prize are offered by the National Electric Water Heating Council—The Modern Kitchen Bureau.

Details and rules of this contest have been distributed to utility companies on several occasions, and may still be obtained from The Modern Kitchen Bureau on application.

Entries close on December 31. The prize is worth winning. The Bureau expects a large and representative entry list. Utilities which have not already notified the Bureau of their intention of entering the contest should do so at once.

APPENDIX

Notes and References for Comments on TVA's Allocation of Investment in Dams

(*Continued from page* 476)

19. Unified Control for Interstate Powers by A. E. Morgan before Interstate Commission on Delaware River Basin, Philadelphia, Pa. December 10, 1937. TVA Release. p 9.

20. House Document No. 328, 71st Congress 2nd Session, Part 1, pp 98 and 99.

21. 1939 Independent Offices Appropriation Hearings, p 919, using cost of Wilson Dam shown in footnote 1.

22. Volume II Transcript of Record of Tennessee Electric Power Company et al Appellants vs TVA filed April 18, 1938 before Supreme Court of the U. S. October Term, 1938, No. 27. p 1166.

23. Hearings Before the Committee on Military Affairs House of Representatives 72nd Congress 1st Session. p 354-355. (January 12, 1932.)

24. The Budget of the United States Government for Fiscal Year Ending June 30, 1936. p 707 (TVA File).

25. Chattanooga Times, July 7, 1938.

26. Congressional Record, Appendix, March 16, 1937, p 2968. Address of Hon. William M. Whittington of Mississippi on March 12, 1937 at St. Louis, Mo.

27. Tennessee River and Tributaries, House Document 328, Part I, p 79. 73rd Congress, 2nd Session.

28. Volume III, Transcript of Record Supreme Court of the U. S. October Term, 1938, No. 27. The Tennessee Electric Power Co. et al vs TVA. Testimony of Sherman M. Woodward, TVA Chief Water Control Planning Engineer. p 1816.

29. House Document 259, 74th Congress 1st Session. p 33.

30. Volume II, Transcript of Record, U. S. Circuit Court of Appeals, 5th Circuit, Ashwander Case, Defense Exhibit No. 23, pages 772 to 776.

31. Volume III, Transcript of Record, Supreme Court of the U. S., October Term 1938, The Tennessee Electric Power Company et al vs TVA, testimony of Joseph H. Kimball, Principal Hydraulic Engineer in Charge of Flood Control Section of the Planning Department, page 1838.

32. House Document No. 90, 70th Congress, 1st Session, page 22, states "In other words, it will take at least 7,000,000 acre-feet in the Valley and 11,000,000 acre-feet in headwater storage to reduce gage heights in Arkansas City." (Valley storage is shown in this report, p 21, paragraphs 85 and 86, to be several times more effective than headwater storage in reducing gage heights. Therefore 10,000,000 acre-feet on the Tennessee would produce actually less than half of the combined result.)

33. Comprehensive Report on Mississippi River Basin, 74th Congress 1st Session, House Document 259. pp 71-82.

34. Mississippi Control Works Tested by Flood by Major General J. L. Schley, Chief of Engineers, U. S. Army, Engineering News-Record, April 14, 1938. p 536.

35. Hearings Before the Subcommittee of The Committee on Appropriations House of Representatives, 75th Congress 1st Session on the Second Deficiency Appropriation Bill for 1937. p 345.

36. The Dallas, Texas Morning News, July 27, 1938. The New York Times, July 28, 1938.

37. Economies of the Power Industry by Col. William Kelly, NELA Pub. No. 1105, p 248. Cost of Generation of Energy (Phillip Sporn) Civil Engineering, January, 1937, p 52. Summary Report of the Federal Trade Commission, Volume 72-A. p 780.

38. Business Administration for Engineers, Harding & Canfield, McGraw Hill Book Co., 1937. p 463.

39. See Exhibit (E), Ratio of Funded Debt to Capital Investment. (Due to space limitation this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)

40. See Exhibit (F), Ontario Hydro Commission Fixed Charges. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)

41. See Exhibit (G), Ontario Hydro Commission Interest. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)

42. Proceedings American Society of Civil Engineers, Vol. 64, No. 6. p 1269.

43. Proceedings American Society of Civil Engineers, Vol. 64, No. 6. p 1268.

44. See Exhibit (H), Ontario Hydro Commission Cost of Power to Municipalities. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)

45. Hearings Before the Subcommittee of the Committee on Appropriations, House of Representatives, 75th Congress 2nd Session on the Independent Offices Appropriation Bill for 1939. pp 971 and 973.

46. Ibid. pp 919-920.

47. Ibid. p 919.

48. Proceedings American Society of Civil Engineers June, 1938, p 1269. Discussion of Harry A. Wiersema, General Office Engineer TVA, Knoxville, Tenn.

49. Hearings Before the Subcommittee of the Committee on Appropriations, House of Representatives, 75th Congress 2nd Session on Independent Offices Appropriation Bill for 1939, p 919, using cost of Wilson Dam shown in footnote.[1]

50. See Exhibit (I), Ontario Hydro Commission. Cost of Transmission Line and Substations. (Due to space limitations this exhibit is not reproduced herein. Interested readers may secure mimeographed copies of exhibits A, B, C, D, E, F, G and H, noted in this appendix, by request to the Edison Electric Institute.)

51. Independent Office Appropriation Bill Hearings Before Subcommittee of House Committee on Appropriations, p 977.

52. Ibid. pp 999 and 1000.

53. Majority and Minority Reports of the Muscle Shoals Inquiry, House Document No. 119, 69th Congress 1st Session. p 74.

CONVENTIONS AND MEETINGS

NOVEMBER

15 General Sales Committee, EEI, Hotel Cleveland, Cleveland, Ohio.

15-18 National Association of Railroad and Utilities Commissioners, New Orleans, La.

DECEMBER

5-6 Prime Movers Committee, EEI Headquarters, New York, N. Y.

6 Hydraulic Power Committee, EEI Headquarters, New York, N. Y.

12-14 Second Annual Accounting Conference, EEI-AGA, Palmer House, Chicago, Ill.

FEBRUARY

5-10 National Electrical Manufacturers Association, Waldorf-Astoria Hotel, New York, N. Y.

6-7 Electrical Equipment Committee, EEI, Statler Hotel, Buffalo, N. Y.

9-10 Transmission and Distribution Committee, EEI, Sagamore Hotel, Rochester, N. Y.

MAY

2-4 Chamber of Commerce of the USA, Washington, D. C.

14-18 National Electrical Manufacturers Association, The Homestead, Hot Springs, Va.

21-25 National Electrical Wholesalers Association, The Homestead, Hot Springs, Va.

JUNE

5-9 EDISON ELECTRIC INSTITUTE, Waldorf-Astoria Hotel, New York, N. Y.